THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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RAPID TRANSIT IN LONDON.

MAY we not pause a moment in the construction of tube railways to consider whether, after all, these offer the best solution of the problem of rapid transit in London? We say in London advisedly, for we entertain no serious doubts as to the eminent suitability of a deeply buried tube railway for the conveyance of passengers into the suburbs. Experience has shown that the tube railways are expensive to construct—probably much more costly than was originally estimated. The work of boring has been comparatively slow. The rate has only been increased by making a break into the work at several places at once, and this, of course, has involved the employment of so much more plant.

The main object of a tube railway, the *raison d'être* of its existence, as of every other railway built with private capital, is to earn dividends. To earn a dividend there must be revenue, and revenue is provided by passengers. With a system of uniform fares, and tickets collected at the station of entry, the traffic from each station is known with certainty, but except by actual count of the outgoing passengers, there is no means of knowing how many passengers get out at each station, and even if there were, there is no way of knowing the length of journey made by each passenger. Nevertheless, the management of the Central London Railway as the result of a special inquiry are in possession of information which tells them, or at least leads them to suppose, that the motor-'bus has taken away revenue from the railway by diminishing its use by the short-distance passenger. Nor need this be any matter for wonder. To pay 2d. for a 1d. journey does not meet the views even of rich men. Poor men will pay the extra penny ungrudgingly if it serves some end, such as the saving of time, and we can understand that the railway did often serve this end, as compared with the horse-'bus. But it does not do so as compared with the motor-'bus. The tube suffers from several causes of delay.

First, the passenger has to wait for the lift. The lifts occupy time in their journey, and there appears to be a growing tendency to delay the starting of the lifts in order to carry a fuller load. These long waits annoy passengers. Much time is spent in long walks from the lifts to the platforms, and a considerable amount of stair climbing has to be done by the passenger, who, if at all dilatory, may fail to reach the lift before it ascends. Now, all these delays form an appreciable addition to the time occupied by the short journeys of a tube train, though, on the long journey all the way, they are but trifling additions. Hence the success with which the motor-'bus competes for passengers picked up, as it were, from the kerb. We are reminded by a New York correspondent that, nearly 20 years ago, a serious endeavour was made to introduce into London the system of shallow subway railways which has proved so very successful in New York, despite

considerable complaint on the score of ventilation in summer time.

The promoters of the London subway, which was intended to extend from St. James Street, Piccadilly, by way of Shaftesbury Avenue to Holborn Circus, with subsequent extension to the Bank, spent some £10,000 on a Bill in Parliament. This was thrown out, largely because of the evidence of the London County Council, which, in the person of the late Chas. Harrison, vice-chairman of the Council, stated the intention of the Council—then a few weeks old only—to construct such subways itself. Thus, from the very first, we see the Council inimical to private enterprise, and nothing has been done either by the Council or by any private company since, for the Kingsway line cannot be classed as a subway of the type we have in mind. In the scheme of 1889 there were to have been stations at the two termini, and intermediate stations at Piccadilly Circus, Cambridge Circus, Museum Street and Chancery Lane. The subway was to have been at a depth below the surface no greater than was necessary to provide a sufficient thickness of roadway above, and, perhaps, even too much was attempted by way of keeping down the total height of the electrical cars. The promoters, however, laid great stress upon the desirability of reducing the height of the stairways to a minimum. They had before them the somewhat lengthy stairways of the District Railway, and the height of New York's elevated lines, and they stretched every point in favour of minimum stairways. Events have shown that they were right in this. The intention was to remove the whole of the material of the street down to the formation level of the railway : to provide entrances by taking shop premises, and to lay all water and gas mains and electricity conductors in lateral galleries, the pipes being looped behind the stairways. This system appeared necessary in view of the narrowness of the thoroughfares traversed by the line, but probably it would have been found more convenient to place the pipe galleries lower than the railway, and possibly to use these pipe galleries as exhaust airways, drawing air into them by means of fans, so that there would always have been a thorough ventilation of the line, and thorough protection against any possible accumulation of gas such as might have resulted from leakage. Each train was to have run in its own tunnel, a longitudinal septum being intended to facilitate ventilation as a consequence of train movement.

Now the New York subway is this proposed London subway, modified in many respects, enlarged in scale, and with electrically-driven trains run at speeds that were not contemplated in the London scheme, though in some respects the London scheme was, perhaps, ideally in advance of anything carried out in New York.

In the American line the available street width is so great that for the distance from South Ferry to 96th Street, a distance of 6½ miles, there are four tracks ; the station platforms are under the side walks and receive light abundantly through perforated grids filled with glass cylinders. The ticket offices are accommodated there also. The depth below street level is small, though at some stations, such as Brooklyn Bridge, the first platform runs over the tracks, so that access may be had to the express tracks. There are, however, only about five of these express platforms ; the others do not require to be so deep, therefore it is easy to reach the trains. There is no extensive walk from the entrance. In many places there are entrances from places of business, as out of the *Times* Building. Though improvements can be seen to be possible and mistakes may have been made, there is certainly no room for carping criticism, and the subway is a great and eminently useful and satisfactory work that is now absolutely essential. The acceleration of the trains is very rapid. Their retardation is great, so that the coefficient of friction between ordinary trousering and the woven cane seats barely suffices to give longitudinal stability to a passenger. In fact, he is very apt to slip along on the seat.

The difficulty of construction in New York was in certain respects less than it would be in London, because much of the line was in rock which had to be blasted, and there was no risk of disturbing the foundations of buildings. But in the lower part of the island there is no rock, and here the construction would be fully as difficult as in London, and demand the same care to avoid injuring the buildings alongside. Probably a four-track line could not be everywhere constructed in London, but on certain special routes it might be contrived to run expresses on a possible third-track, in cases where an express service was needed up in the morning and down in the evening.

It is very certain that such a line would attract to itself a traffic that would not use the tubes. Accessibility would insure this. The gain from such a line, apart from the traffic facilities it would give, would be that there would be provided that most desirable thing, a subway for pipes. Work on the street surface would be greatly reduced, except for repavement. It would be possible, from the accounts of the various companies concerned in breaking up streets, to ascertain what capitalisation was represented by the expense of street work. As to noise, the subway trains are scarcely audible on the surface. One hears them when passing the open stairways, and that is about all that can be said. We think that before more capital is sunk in deeply buried tubes a full investigation of the subway system ought to be made. We believe it never has been made since the promoters of the 1889 scheme were defeated on the Bill, and it cannot but be regretted that so much money was spent in endeavouring to overcome an opposition which had in it so little regard for the needs of London.

As already stated, we say nothing against the tubes. They have proved themselves unable to attract the short-journey passenger, who alone, we fear, can make of them a financial success, and unless extended further afield we do not see how they are to gather up a sufficient number of suburban passengers. Compared with New York, their long-distance fares are high ; on the general purchasing value of the coins they are doubly as dear. In New York one could travel from Baker Street to Herne Hill for 5 cents. Nominally 2½d., the 5-cent fare is only 1¼d. on the purchasing equivalent in other goods. There are, however, very many conditions to be taken into consideration in fixing fares, and the recent experience of the Metropolitan District Railway shows the necessity of caution in reducing them.

German Enterprise in South America.

The German Transmarine Electricity Co., of Berlin, which is specially concerned with lighting and tramway undertakings in South America, is gradually developing into an enterprise of considerable proportions. During 1906 the share capital was increased from £1,800,000 to £3,600,000, and it is now proposed to make a fresh issue of obligations which will raise these bonds from £750,000 to £1,500,000. The generating stations owned by the company at Buenos Aires have a capacity of 35,210 H.P., and a beginning has been made with supply to the suburbs. It is intended to erect a new station, and a site has been acquired for the purpose, and orders placed for turbo-generators of 7,500 KW. The company's holding in the Chilian Electric Tramways and Light Co. has been increased, and now amounts to £648,735 in preferred shares and £385,113 in ordinary shares. A waterfall capable of yielding 20,000 H.P. has been acquired by the Transmarine Co. in the vicinity of Santiago, and the sum of £300,000 is

to be expended in the next two years for the installation of plant of 16,000 H.P. An agreement has been concluded with the Chilian company in question for the supply of power, and on the completion of the hydro-electric station the latter company will obtain all its supply from it. The Transmarine Co. has acquired the whole of the share capital of the Valparaiso Tramway Co., nearly all the shares in the Tranvia al Paso del Molino y Cerro at Montevideo, and the entire share capital of the Tranvia Oriental. The two latter have been amalgamated under the title of La Transatlantica, and the tramways are being extended. The net profits of the Transmarine Co. in 1906 amounted to £304,691, as against £152,478 in the preceding year; and a dividend of 9½ per cent. has been declared, as compared with 9 per cent. and 8 per cent. in the two previous years respectively.

"S. P. Q. R." It is frequently charged against British Governments that they are unreasonably apathetic in regard to matters relating to trade development. We do not suggest, in the light of practical experience, that the charge is altogether unfounded—indeed, we have gone so far as to support the complaint ourselves at times, but when a grant of money is made by our Government for making a British display at an International Exhibition with a view of aiding British industry on the Continent, why is it that practically one-half of that allowance remains unexpended? For the purposes of the British Commission in connection with the Milan Exhibition of last year, there was a grant of some £10,000. Yet when the various items are audited there remains £4,936 to the credit of the account, and we are now told that £4,700 of it is to be returned to the Treasury pending final settlement of the accounts. Perhaps on some future occasion the Government may be induced to make a grant of £20,000, in the hope that those who are possessed of an overwhelming zeal for British trade development may modestly spend a half. It seems absurd to ask for Government assistance, and then to fail to use it to the full. Surely it would have been possible to legitimately spend those embarrassing riches at the Milan Exhibition in such a way as to pave the way for—say, bigger electrical trade between this country and Italy. Of course, in these days which are so marked by national economies there may have been special reasons weighing with the responsible parties who dealt with the matter. No doubt the Government Committee that has lately been considering the whole question of international exhibitions will have had Milan doings before it, but we hope that in any suggestions that its members make regarding the future they will not think too much about the return of that £4,700.

Engineering Apprenticeships: The Student's Point of View. In the *Engineering Magazine* for May appears an article by H. Cole Estep, in which the point of view of the student towards the "Engineering-Apprenticeship Courses" is presented. Whilst the point of view is that of the American graduate towards the apprenticeship courses offered by most of the leading engineering manufacturers in the United States, where a longer experience in student-apprenticeship has been gained than in this country, it is possible that the views expressed may be to some extent reflected in the near future among the engineering graduate section passing from our technical institutions into British workshops. As the author points out, if the attitude of the technical student is not one of sympathy but of indifference, then the continued success of the system is in danger. Admitting that the apprenticeship idea is fundamentally sound, and that much time and money have been spent in perfecting it, the system will end in failure unless there is a sympathetic co-operation between the engineering employers and the men for whose benefit the student-apprenticeship has been designed. The author's view—and he claims to have been intimately associated with the students in the large universities of the middle West Pacific coast—is that the present attitude of the engineering graduate is apathetic, and detrimental to the best interests of the apprenticeship idea. After spending three or four years in a technical college, he only turns to an apprenticeship course as a last resort, after having failed to get something better and more profitable.

The reasons given for this state of affairs are—that the courses offered by many of the firms are too stiff and inflexible, that the wages offered are not a sufficient inducement, that the courses are too long, that there is no reward at the end, and that the invention clause existing in many apprenticeship contracts is unfair. The author combats the argument that the engineering apprentice absorbs the time of valuable men and spoils material, the cost of which must be set against him. As a rule, he maintains, the apprentice is given a few brief instructions by the foreman or attendant, and then left to shift for himself, and is of opinion that in many departments the raw apprentice earns as much as the fully-trained man. This being so, it is claimed that he should be paid as much as he is worth, and that the antiquated flat-rate system should be dropped and a modern piecework or premium system be applied all round, a proposal which would scarcely fit in with the notions of British trades unionists.

The feeling may not be the same in America as in this country, but there is no doubt that over here there is a certain amount of prejudice on the part of the non-technically trained foreman towards the collegiate apprentice; and, on the other hand, there is a disinclination on the part of the well-educated youth to take instructions from a foreman whom he considered to be his mental and social inferior. In countries where military service is compulsory this feeling gets to a large extent broken down, and a stricter sense of discipline is maintained in the workshops in consequence. Anyone who has visited the large engineering workshops on the Continent must have noted the authority with which the foremen are invested, and the strict sense of discipline which is maintained throughout the works. This feeling rarely obtains in English workshops, the foreman being generally regarded by the men as more or less one of themselves.

Copper. During the past month there have been no violent fluctuations in the price of copper, but, at the same time, the market for the metal is lacking in firmness and ready to respond to temporary influences in a manner rather disappointing in so respectable a commodity. The opening week of May saw consumers coming in on the set-back in price which prevailed at the end of April. Shortness of general stocks soon influenced the market, and the price recovered to £105 15s., speculators who had bought at the low prices tending to keep down excitement by feeding in their holdings. The 15th saw Standard down to £102 7s. 6d., buyers apparently having satisfied their immediate needs, or been driven out by the rise in prices which takes place as soon as they approach the market.

The mid-monthly supplies only rated 11,603 tons, a considerable decline from April, with 13,780.

The depression extended evenly throughout the month, the price for the 15th being £102 7s. 6d., and for the 24th £102 5s.

Reports for the 27th again indicate a depressed condition of the market, with little buying, apparently due to unsettled conditions in Wall Street, and a general tendency to wait on either side—dealers waiting until buyers are again forced in, and buyers in hope of the increased output which seems so long in coming. The price remained in the neighbourhood of £102. For the electrical manufacturing companies, and others to whom copper is a necessity, the present year has not, so far, been a very pleasant one. It is probable that their opportunity may arise when supplies begin to show an upward tendency, and the price jerks in sympathy. A very little in the way of rumour appears to affect the market, and, consequently, the next scare will be looked for with considerable interest.

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TELEGRAPH SWITCHING: METROPOLITAN INTERCOMMUNICATION SCHEME.

(*Concluded from page* 833.)

A front view of a portion of the switchboard, showing a double cord section to the right and a single cord section to the left, is shown in fig. 6. The two lowest rows of jacks and lamps upon the former belong to the home section. Three double cords and two single cords are shown in use for through connections.

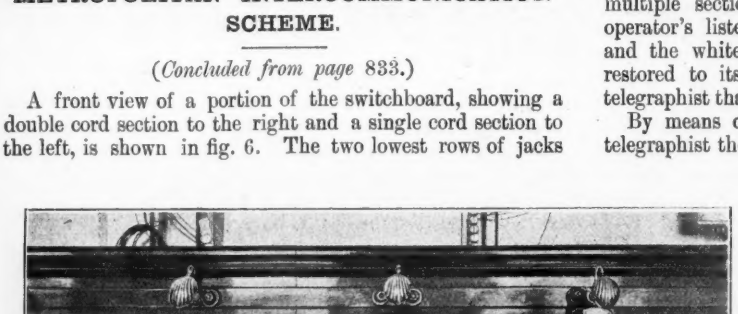


FIG. 6.—SINGLE AND DOUBLE CORD SWITCHBOARD SECTIONS.

The electrical principles on which the working of the system is based will be evident from an examination of figs. 3, 4, 5 and 7, which show, in skeleton, the connection of the main signalling circuits.

The operations involved in the transmission of a message, *e.g.*, from Wandsworth to Holloway on double-cord lines, can be followed in detail by means of the diagrams, and are as follows :—

The message handed in at Wandsworth is marked with the number of the delivery office (Holloway) before being taken to the instrument for transmission, the number being obtained from a delivery list, containing 50,000 to 60,000 references; it is then taken to the telegraphist, who calls the Central Office switch by depressing the plunger of a special electromagnetic indicator key. By this operation a large white star (normally hidden) is displayed on the cover of the key, and the coil of the key is joined directly between the line and earth through the contact made by the plunger, the armature being retained in this position by the magnetisation of the coil. The whole of the apparatus resistance at Wandsworth is thus short-circuited by this coil, which measures 50 ohms only, and the strength of the current flowing in the line is augmented from 6 to 66 milliamperes. This actuates the line relay at the Central Office, and lights the lamp, indicating a call at the home section of the switch.

The switch operator inserts a peg in acknowledgment, and bythis single operation the cut-off relay is actuated, the line relay disconnected, the calling lamp extinguished, the engaged lamps on the Wandsworth line lighted on all the multiple sections, the translating relays on the switch operator's listening set brought into circuit on the line, and the white star on the cover of the Wandsworth key restored to its normal position, indicating to the calling telegraphist that the switch-operator has come in circuit.

By means of the ordinary Morse key the Wandsworth telegraphist then calls for Holloway by signalling the number of that office. The switching operator reads the call, selects—aided by the engaged "lamps"—a disengaged line to Holloway, completes the connections by the second peg of the pair, and cuts the listening set out of circuit by the speaking key on the cord circuit. Wandsworth and Holloway are now in direct communication, as shown in fig. 7, and the message is signalled by means of the battery and translating relays at the Central Office. The manipulation of the Morse key at either end augments the current from 6 to 28 milliamperes, and this actuates the corresponding translating relay, which, in turn, transmits double-current signals to the receiving instrument, a polarised sounder, at the other station.

On the conclusion of the message, both stations depress the plunger of their indicator keys, displaying two white stars; a current of 66 milliamperes passes through, and, actuating the "clearing" relay (which is so biased as to be unaffected by the working currents of 28 milliamperes), the clearing lamp connected to the cords in use is lighted, and the switching operator is apprised that the communication is ended. The pegs are withdrawn, thereby severing the connection, extinguishing the engaged lamps on both lines, reconnecting the line relay, and restoring the white stars at both out-stations, indicating to the telegraphist that the connection has been cleared and that the lines are available for a fresh call.

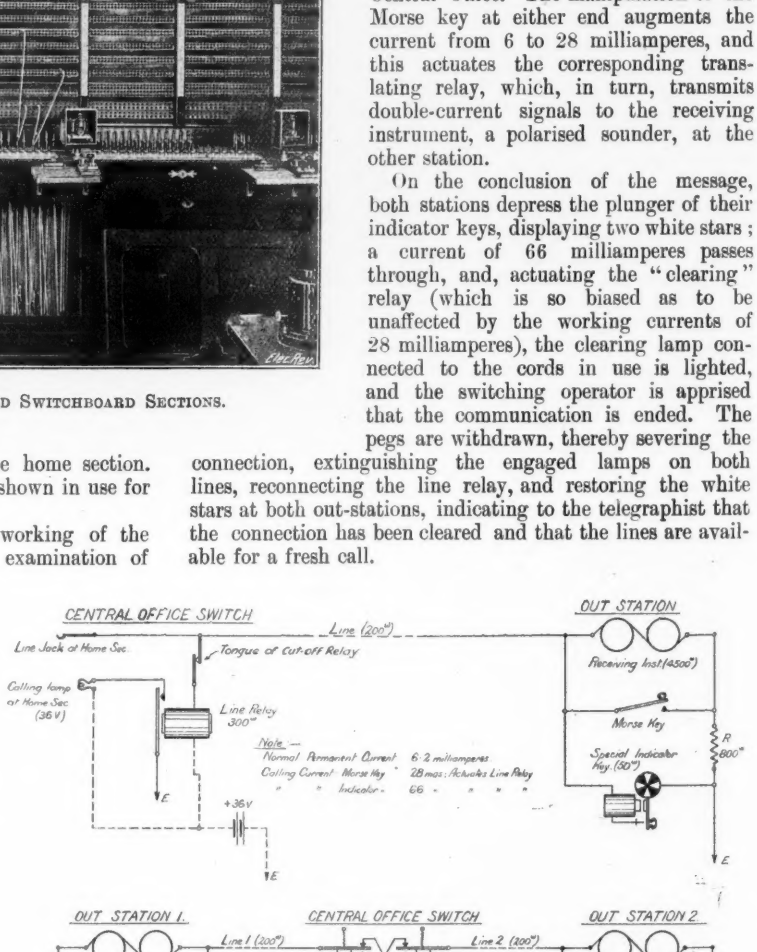

CENTRAL OFFICE SWITCH
OUT STATION
Line (200")
Line Jack at Home Sec.
Tongue of Cut-off Relay
Receiving Inst (4500")
Calling lamp at Home Sec. (36 V)
Line Relay 300"
Morse Key
Special Indicator Key. (50")
R 800"
Note —
Normal Permanent Current 6·2 milliamperes
Calling Current Morse Key " 28 mas: Actuates Line Relay
" " Indicator " 66 " " " "
+36V
E
OUT STATION 1.
CENTRAL OFFICE SWITCH
OUT STATION 2
Line 1 (200")
Line 2 (200")
Polarised Sounder (4500")
Translating Relays
200"
800"
Clearing Lamp (36V)
Clearing Relay 100"
50"
+36V
-40V
Note: Normal P.C. on each Line - 6 milliamperes 'spacing'
Current on Sending Line - 28 mas: actuates Translating Relay
do Receiving do - 6 " marking - Polarised Ind"
do Line clearing first - 66 " actuates Clearing Relay.
Translating Relay and Indicator Key
Current on Line clearing second 38 mas actuates Ind" Key.

FIG. 7.—THROUGH CONNECTIONS OF OFFICES IN COMMUNICATION.

To answer a call on a single-cord line (see fig. 5) it is unnecessary to touch the peg; the required operations are effected by turning the cord-speaking key and bringing the switching operator's listening set into circuit. The same

relay and lamp are used both for calling and clearing. When the peg is in its normal position, the relay will respond to signals either from the Morse key or indicator key at the distant station, but when the peg is lifted to complete the through connection, a shunt coil is automatically thrown across the relay, which is thus rendered less sensitive, so as to be unaffected by the passage of working signals, and will respond only to the increased current sent by means of the indicator keys to give a clearing signal.

Calls for connection to a working set at the Central Office are sent by the Morse key, and give a flickering ; calls for connection to another out-station are sent by the indicator key, and give a steady light. The switch operator can thus distinguish between the two classes of calls, and can deal with the former without bringing the listening set into circuit. Such calls are, during specially busy hours, plugged through by an assistant operator unprovided with a listening set. This operator can also effect clearances, and so relieve the principal operator of all work, save that of reading the calls for and making through connections.

By the insertion of balancing coils when necessary, the resistance of all the circuits is made approximately 200 ohms, and, therefore, the currents sent by similar operations at all offices are of the same strength.

In order that Greenwich Mean Time may be signalled from the Central Office to every out-office daily at 10 a.m., the putting through of calls upon one wire to each office is stopped at 4 minutes to 10. At 2 minutes to 10, a special switch is turned, which connects these lines to a single-current key, by means of which the word "ten" is signalled to all offices simultaneously, the initial letter "t" being given exactly at the hour.

A permanent current of 6 milliamperes on all circuits is supplied from a group of 18 secondary cells of 720 ampere-hours' capacity, fitted in the basement of the General Post Office. Between the hours of 8 p.m. and 8 a.m. current is supplied on the "Time" wires only, which thus form a channel by means of which any station can call the Central Office at any hour of the night and on Sunday. The auxiliary "direct" circuits, simplex and duplex, are also worked on the common battery principle.

Although the installation of this intercommunication system is still incomplete, it has already given very gratifying results in the acceleration of local telegraph business, and from an engineering standpoint, the working of the system has from the first been entirely satisfactory.

The apparatus at the out-stations is of a very simple nature, and rarely requires attention. A main feature of the design has been the concentration of all the more complex apparatus at the Central Office where skilled attention is always available.

The switching system has attracted considerable attention in this country and abroad, and it is generally regarded as a unique example of telegraphic equipment, testifying to the progressive character of the British Telegraph Administration.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Electrical Trade.

I have read your leading article in the columns of this week's issue with much interest, and would especially like to draw attention to one of the many branches of the above subject—namely, the position of things in the contracting section of the electrical profession. Electrical contractors of to-day are feeling the keenness of competition more than ever before, and the fact that it is in many cases unfair competition aggravates the evil. Now is the triumph of the small man, who scores an advantage over his larger and older-established competitors, paying as he does a small rent, living in obscure premises, and employing cheap labour and inferior materials. The ramifications of the jerry-wirer are as complete and far-reaching as those of the jerry-builder, and the effects of his work as regrettable and disastrous. Largely to his account must be debited the appearance of the municipal specification of unbending and grasping repute, and the fact that work under these rules and conditions has become practically impossible to all but himself—provided that he has enough capital to undertake municipal contracts.

But he heeds not the volumes of wrath and anathema that are heaped upon him with vigour from all quarters of the electrical world, but continues with greater keenness to underprice his fellow contractors which he manages to effect, owing to the trusting simplicity of the public, which allows him to foist upon it his inferior workmanship, which the firm with a reputation does not wish and cannot afford to do. The electrical trade is not by any means overcrowded with trustworthy firms ; it owes its vastly increased numbers in many cases to the above described individual.

What is the remedy ? One and all have agreed that until the time when *hoc genus omne* shall be compelled through legislation to desist from a competition which is one of price only and not quality, and consequently begins to find that he can no longer compete with firms of integrity, it cannot be worth while for contractors to continue fighting the one-sided battle between a superior firm which uses high quality but also more expensive goods, and the shoddy jack-of-all-trades individual who buys cheap and nasty goods and employs underpaid and inexperienced boys to do his work. But as yet there is no law, and it is increasingly evident that the jerry wirer finds his pursuits lucrative, and this bodes ill for the class of work he turns out, considering that in price he manages to cut most old-established firms clean out of the running. Until an Act is passed the solution rests with the public, which should be taught to insist upon good sound work, which once paid for remains good, rather than to indulge in the short-sighted policy of being satisfied with that whose only recommendation is its apparent cheapness.

Perhaps in the future we may hope for the only satisfactory answer to the problem—a universal standard—but at present, in London, there are some thirty odd electrical supply companies with more or less different rules and methods, as well as almost as many fire insurance companies, in addition to the Institution of Electrical Engineers. A law of this sort having been made, the standard of goods and workmanship would be raised to a common equality, and competition would be relegated to skill, speed and business-like methods, the seizing of opportunities for preference in dealing with manufacturers, and a close study of the markets. Where there is no standard of quality there can be no limit to the cutting of prices, and *ipso facto*, the consequent inferiority of work ; and the question now arises of how to formulate a rule which is applicable to the large majority of cases. Types, qualities and ideas change frequently, and what is in vogue to-day, may be neither desirable nor efficient to-morrow.

A more rigid test and examination by some authority of all work done would, perhaps, meet the case ; it would probably not affect the contractor whose practice has always been to maintain his principles, but it would considerably reduce dishonest and inferior dealings, a consummation devoutly to be desired.

W. J. Henry.

Westminster, *May 24th*, 1907.

Of Dogmatism in Science.

I was quite prepared for Mr. Carter's "I prefer to follow Maxwell," and for his appeal to "the official view of scientists." It was against just such a spirit of discipleship that my article was directed. If it is to be a question of authority, it might be asked whether even Maxwell were entitled to alter the meaning of *Faraday's* dielectric constant. Hertz, too, no mean authority, retains the old definitions, and makes μ and κ always numerics, and each unity for air. Of course, he does not get $1/\sqrt{\mu\kappa}$ for the velocity of the electromagnetic wave. I endorse Mr. Carter's statement that the velocity is independent of the units used in measuring it, but its numerical expression obviously depends on those units. Whether it be more outlandish to adopt (provisionally) $1/3 \times 10^{10}$ seconds as the unit of time

or $1/9 \times 10^{20}$ as the dielectric constant of air, everyone must decide for himself. I did not suggest the special system of units for practical use, but merely as one means of interpreting the result.

If Mr. Carter will look at my article again, he will see that I did not cite these equations as an instance of dogmatism in science, but as an illustration of the fallacy that may lurk in a coefficient. My charge was that the meaning of μ, or K, or both, had been changed to make the result accord with facts; Mr. Carter implies that the change was made in an earlier stage to bring the two series of equations to the same system. I am quite ready to accept his version; it seems to me to make very little difference.

W. M. M.

Electrically-Driven Cement Works.

In your issue of May 17th I notice in your article on "Electrical Driving in a Hartlepool Cement Works" a statement which seems hardly correct. It is this:—

"The installation is particularly interesting, as being the first cement plant in this country to be electrically-driven throughout."

About seven years ago, being then engaged with a well known firm of electrical engineers in the north of England, I erected in Kent complete electrical equipment for driving eight rotary kilns and the attendant coal-crushing, conveying, slewing, mixing and other plant. Everything was electrically-driven throughout, even to a lift and an electric locomotive.

The works had its own generators—two 440-volt D.C. of 750 KW. each—with balancers.

The rotary kilns were driven by 25-H.P. series motors with controllers.

The coal-crushing plant was driven by a 125-H.P. motor.

Alfred S. L. Barnes.

Gibraltar, *May 21st*, 1907.

Seats for Drivers.

One of the most tiring occupations in the service of electrical engineering is that of the tram driver. He is forced to stand in one position for over eight hours every day, and earn a few coppers per hour at the expense of his aching legs, exposing them to dangers which might easily result in his becoming crippled for life.

Why not, then, supply him with a seat, as per enclosed sketch. This seat might be made with a saddle like that of an agricultural mowing machine, only sloping forward so as to allow the motorman to manipulate his bell, sand, and brake ratchet. The spindle might be made to screw into a pedestal like a music stool, so as to raise or lower it to suit the length of the driver's legs. The shoe could be made to fit into a socket in the floor of the car with a flange about it. Such a seat could be planted by the driver at whichever end he was driving from.

R. T. Legh-Powell.

Wakefield, *May 25th*, 1907.

"Electrician" Wanted.

An advertisement appeared in a well-known "daily" recently for "An Electrician," to take charge of the plant on a gentleman's estate. The man appointed had to carry out any new additions or alterations, do all repairs, &c. Being desirous of a shift, I put in my application and copies of my qualifications for the post.

At last a letter came asking me to call on Mr. ———, at X Y Hotel, which accordingly I did. After a few moments Mr. ——— made his appearance, and asked me "this way," to his room. Seated there, Mr. ——— went on to say that he had a fairly large installation on his estate, and was not quite satisfied with his present electrician; he had had to renew his batteries at least twice in the last few years (owing to inexperienced attendance I found out), and now wished a qualified man to take entire charge of same; judging from my qualifications, he was of the opinion that I would suit him. Being willing to better myself if possible, I made inquiries as to the salary offered.

This opened a new feature in the proceedings when my friend went on to say that, owing to the fact that the engine would not require to be run every day, there were other duties that he would require of me (duties not mentioned in his "advt.") Among others, he named the following:—Pump water to the house, saw wood, carry messages, telegrams, &c., act as private secretary or factor, trap game, do shooting, beat carpets, repair gates, &c., and then to sum up I was actually offered the magnificent salary of 21s. per week!

Now, Mr. Editor, I am not a professor of things in general, but I have a faint idea of how to manage an electric installation, and if the gentleman in question imagines he is going to get a qualified man for 21s., I am afraid there is something wrong somewhere. After spending five years at college, together with 15 of practical experience, I am not in the least afraid of how to charge his batteries, &c., but for the beating of carpets, &c.—well, I was not taught that branch in my college career, unfortunately.

I believe the gentleman has been put to the expense of £200 or £300 for renewals, caused by men in his employ, gardeners, I presume, looking after his plant, and not knowing what they were doing, and now he wants a qualified man *at an estate labourer's wage*. He has, no doubt, got sick of expenses caused by cheap labour, but it seems that he would rather continue to pay such than pay a proportion thereof to a qualified man.

Were I reduced to the level of a scavenger, no corporation in this district would have the audacity to offer me so low a wage as 21s. I hope that my friend *the gentleman* will get his *qualified man* somewhere among the 100 applicants who have applied for the post, and from among whom, he informed me, I was the only one he had seen on the matter.

I would be pleased to hear if any of your readers have had any experience with *gentlemen* of this class.

M. T. W.

For British Exporters: A New Association.—We made a brief reference a few weeks ago to a new association that had been established for helping British exporters in the carrying on and developing of their trade with other countries. This organisation is entitled the National Association of British Exporters, Incorporated, and it has its temporary offices at 64, Imperial Buildings, Ludgate Circus, E.C., with Mr. Frank Jordan as its secretary. One of its principal objects is to obtain for its members (subscription, five guineas per annum) a better service of information from foreign markets than is at present supplied by existing government departments or private agencies. The Association is not formed for earning profit, and it is non-political. From the literature that has been placed in our hands by Mr. Jordan, we glean the following information as to the objects of the Association:—

(*a*) The establishing of agents and correspondents in every commercial centre abroad whose duty it will be to call upon buyers in their districts, and to bring to their notice both British products and the firms exporting such goods, at the same time remitting to the central or home organisation full information as gathered, so that the Association can instantly direct the attention of its members to those oversea houses requiring or handling their class of goods.

(*b*) The obtaining of every trade journal of any standing throughout the world and the consular reports of every country upon the trade and commerce of other countries. Immediately on receipt thereof, carefully examining the same and registering, classifying, and indexing for reference all information of any value to British merchants and manufacturers. Also instantly despatching an extract or copy of the information to such traders to whom it would be of importance.

(*c*) By fostering cordial feelings between foreign nationalities and petitioning governments in cases of unjust discrimination against British commerce. Also the petitioning of railway and steamship companies against excessive freight rates to the detriment of British exporters.

(*d*) The furnishing of a "Weekly Trade Report" in pamphlet form of trade opportunities, of the requirements of colonial and foreign markets, and of full particulars of buyers and users therein of every class of goods, and with whom the British trader should become acquainted.

In short, it is intended that the Association should become the centre for merchants and manufacturers wishing to trade in foreign markets where they could ascertain the nature, value, and requirements of such markets, what they can offer in return, what business houses to deal with, and the conditions on which business is usually conducted. It is suggested that there are thousands of manufacturers who might do an export trade, either through the intermediary of merchant houses, or in a direct manner, but they are not equipped to cater for business outside their own country, because of the expense of obtaining information respecting oversea markets and the necessary assistance to accomplish that objective. Their complaint is that they have no place to turn to for assistance and information.

The management of the Association is to be conducted by an executive council periodically elected by the members, and we understand that there will be different sections for watching the interests of particular trades. We are informed that a number of electrical firms have already given in their names. The Association has our best wishes for success, as has, indeed, every serious endeavour to increase the volume of our foreign electrical trade.

THE EFFECT OF CURRENT SHEETS ON THE COMPASS NEEDLE ON BOARD IRON SHIPS.

Even when insulated lead and return wiring is employed on board ship, accidental connections between one wire and the body of the ship result in either the outgoing or returning current flowing more or less in the form of a current sheet, and the neutralisation of one wire by the other is then partially destroyed. An interesting theoretical and experimental investigation of the effect of such an occurrence on the compass needle has been given by C. Arldt in the *Elektrotechnische Zeitschrift*. Referring to fig. 1, if o represents the position of the compass at the origin of the x and y axes, and p is the trace of a conductor running at right angles to the x and y axes, and carrying a current i absolute units, the value of the magnetic field set up at o by p is—

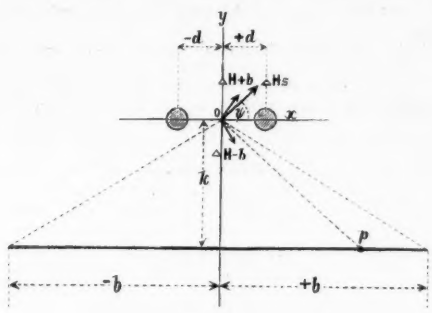


Fig. 1.

$$\Delta H_s = 2\,i / \sqrt{x^2 + y^2}$$

and the component of this field in the x axis is—

$$\Delta H_x = \Delta H_s \times \cos\psi = 2\,i\,y / (x^2 + y^2).$$

For a flat conductor whose trace in the x, y plane is parallel to, and at a distance k from the x axis, the field due to a point p of this trace will be—

$$d H_s = 2\,i_o\,dx / \sqrt{x^2 + k^2},$$

$$\text{and} \quad d H_x = d H_s \cos\psi = 2\,i_o\,k\,dx / (x^2 + k^2),$$

and if x varies from $+b$ to $-b$,

$$H_s = 2\,i_o \int_{+b}^{-b} \frac{dx}{\sqrt{x^2 + k^2}} = 2 \times i_o \times \log \frac{\sqrt{b^2 + k^2} + b}{\sqrt{b^2 + k^2} - b} \qquad (1)$$

$$\text{and} \quad H_x = 2\,i_o \int_{+b}^{-b} \frac{k\,dx}{x^2 + k^2} = 4\,i_o \tan \frac{b}{k} \qquad (2)$$

i_o being the absolute current strength per unit length of trace or

$$i_o = i/2\,b.$$

H_s represents the sum of the magnetic fields produced in the x, y plane by the several current streams in the sheet. The sum is taken independently of direction, so that H_s is a scalar quantity.

H_x on the other hand, is the sum of all the components in the x axis, and is a vector quantity.

If now the original field strength at the point o was H_x in a direction at right angles to the x axis, a compass needle placed at o will be deflected through an angle δ, whose amount, if no iron masses are present, will be given by the expression

$$\tan\delta = H_x/H_c.$$

If, however, iron masses (such as compensating globes) are present at positions $x = +d$ and $x = -d$, the separate values of field due to the elements of the current sheet will be deflected, and will approximately give the effective value at o of H_s in the direction of the line joining the centres of the iron masses. In fig. 1 this line is in the x axis. The lower the saturation of the iron, the more nearly will the value H_s be attained.

If the original field H_c is weak, and acts at right angles to the x axis (say in the z axis), it will hardly be affected by the presence of the iron globes, if they are not too near together. So that for this case—

$$\tan\delta = H_s/H_c.$$

In practice, neither of the above formulæ will be strictly correct, because the current sheet would usually not have a uniform density on account of the disturbance at the incoming and outgoing points, but that the formulæ give an approximation to the true effects is proved by the following experiments:—

A room 14 metres long by 8·64 metres broad, with a sheet zinc floor covering was available. The length of the room lay fairly exactly east and west, and a current sheet was sent from three leading-in points in the northern edge to two leading-out points in the southern edge of the zinc flooring. The effect of such a current was measured by means of the silk-suspended magnetic needle of a tangent galvanometer—the deflections being read through a telescope. The actual current distribution in the zinc would be difficult to obtain, but fig. 2 shows the distribution of lines of force in the corresponding magnetic case, *i.e.*, the three points at which current is led in are replaced by three north magnetic poles, and the two outgoing currents by two south poles. The result is a fairly accurate reproduction of the current distribution. The position of the test needle is shown by the small circle. The needle was 118 cm. above the floor, and it was placed rather to one side, as shown, in order to bring it exactly central between two of the iron beams supporting the building. These beams ran approximately north and south, and helped to lower the horizontal component of the earth's field in the room. This component was found to be $H_c = \cdot1322$ only.

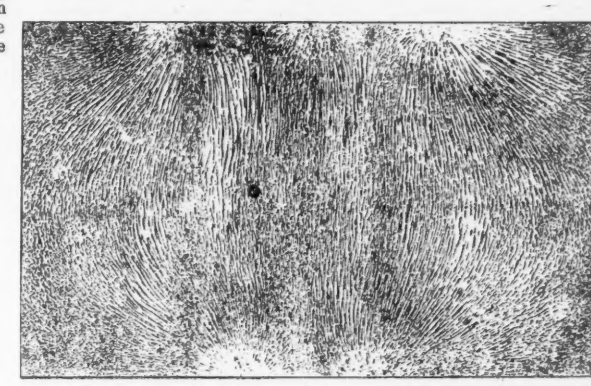


Fig. 2.

The experiments showed the following values for the angular deviation δ with various values of current through the floor sheet:—

i (absolute units)	$i_o = i/2\,b$	δ
·8 ...	·000572 ...	1° 45′
1·44 ...	·001029 ...	3° 4′
2·2 ...	·001571 ...	4° 44′

For the same three currents, formula (1) gives the following values for δ: 2° 28′, 4° 25′, 6° 44′; whilst formula (2) gives δ = 1° 24′, 2° 30′, 3° 49′. When the compass needle was provided with two compensating spheres of hollow cast-iron, 21·5 cm. in diameter, and of a weight of 15·9 kg. each, placed either north and south or east and west of the needle, or at intermediate positions, and at various distances from 30 to 40 cm. from the needle, the effects of the current sheet were only slightly modified. A current of ·8 absolute units, for instance, produced deviation varying between 1° 24′ and 1° 54′ according to the position of the globes. It is evident, therefore, that the actual deviation in all cases lies somewhere between the values given by the two formulæ (1) and (2), and these can be employed to determine the probable effects.

The writer concludes by working out the effects in a particular case which represents the conditions on an ordinary freight or passenger steamer. A lead and return wire are supposed to be situated directly beneath the promenade deck, and the compass is placed on the bridge. The distance between the decks is 240 cm., and the height of the compass above the bridge is 110 cm., so that from the compass to the wires is 350 cm. (11′ 6″). The total width of the ship is 2,000 cm. or b = 1,000 cm. If now faults occur in one of the wires the current will flow as a current sheet in the deck, and the two formulæ show the following effects on the compass needle with various currents:—

(*a*) Assuming that the deck is of iron and entirely screens off the magnetic effect of the remaining wire.

Current.		Angular Deviation δ.	
abs.	Amps.	By Formula 1.	By Formula 2.
1	10	1° 21′	0° 57′
2·5	25	3° 24′	2° 21′
5	50	6° 45′	4° 42′
10	100	13° 20′	9° 20′

(*b*) Assuming that the deck is non-magnetic and produces no screening action:—

Current.		Angular Deviation δ.	
i abs.	Amps.	By Formula 1.	By Formula 2.
1	10	0° 56′	1° 14′
2·5	25	2° 4′	3° 6′
5	50	4° 7′	6° 11′
10	100	8° 12′	12° 13′

The value of the horizontal component of the earth's field is assumed to be ·15.

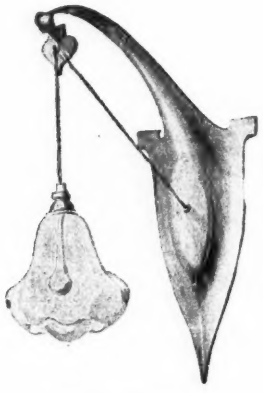
Deviations of the amounts shown above are too great to be neglected, and the author considers that the employment of 3-phase current on ships would be a distinct advantage, since this can produce no effect on the needle.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

"Armorite" Electric Light Fittings.

A few days ago we visited The General Electric Co.'s showrooms in Queen Victoria Street, for the purpose of inspecting their new product "Armorite," which represents an interesting new feature in connection with electric fittings manufacture. We saw various fittings finished in this metal, and the general appearance of these was very pleasing, they possessing a resemblance to oxidised silver that was very striking. This fact, along with the knowledge that they are being sold at about half the price of oxidised silver fittings, should create a considerable demand for "Armorite" styles of finish. *Repoussé* and leaf work carried out in this metal shows artistic improvement on ordinary brass, the veining and the hammer marks standing out in relief in a manner which

Dining Room or Hall Pendant.



Armorite Bracket.

is stated to be unapproachable in any other metal. The permanence of the metal is another strong point in its favour, as we understand that it is rustless and untarnishable. To architects and surveyors and borough engineers, these qualities will undoubtedly appeal, as it is safe to say that the use of "Armorite" in town halls and other public buildings and private residences would save a great deal of that annoyance that is at present caused through the discolouration and detrioration of fittings executed in the ordinary metals. It is equally suitable for ships, and for outdoor situations of all kinds, whether near the coast or inland. We illustrate two or three examples of good designs of fittings made in "Armorite" for private house service, but those who take an interest in artistic electric light fixtures, switch-covers and other metal work would find it well worth while to pay a visit to the company's showrooms to see things for themselves.

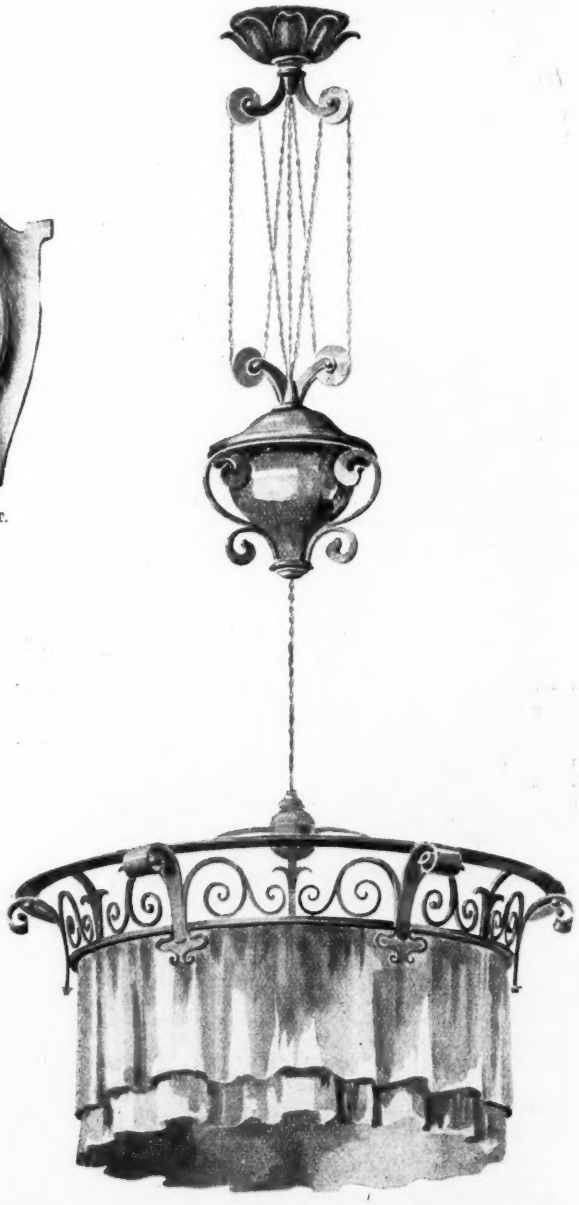
Penny-in-the-Slot Prepayment Electricity Meter.

Messrs. Johnson & Phillips, Ltd., have recently placed on the market an ingenious prepayment meter, of sound mechanical construction, and at the same time sufficiently moderate in price to enable it to meet what is undoubtedly a great present-day want. The meter has been designed for use on small installations when the load cannot exceed 10 8-c.p. lamps.

The instrument consists of a clock (which is wound by the customer automatically each time a coin is inserted), a switch, and an ammeter. A handle projects through the front of the case, but this cannot be turned unless the mechanism is released first by inserting a penny.

When the mechanism is freed, the turning of the handle results in the clock being wound up, the switch being put in circuit and an epicyclic gearing moved a certain distance for each coin inserted. The switching-on of the current releases an electro-magnet, which clamps the balance wheel of the clock movement when no current is passing.

The clock is a regular timekeeper which cannot be over-wound, and its function is to revolve a small cam at regular intervals of 5 minutes; the cam in turning permits the lower end of a lever to take a definite position against the periphery of an aluminium

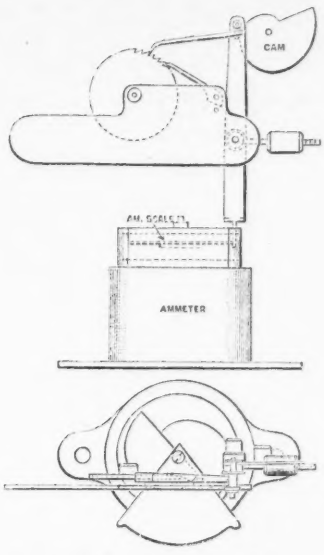


Dining Room Pendant Fitting in "Armorite."

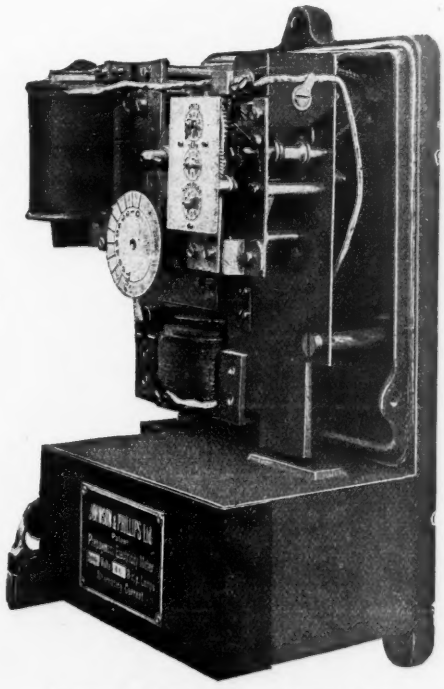
scale on the ammeter spindle, the scale position being, of course, governed by the current passing; a pawl is attached to the upper end of the lever, which serves to translate the movement of the lower end of the lever to a rack wheel, by the agency of the cam in completing its revolution. The rack wheel being directly connected to the epicyclic gearing spindle, moves the gearing in the opposite direction to that in which it was wound by the

operator, and when the prepaid amount is used, a gear arm cuts out the switch.

The meter is very positive in action, and changing from one price per unit to another is a very simple matter, consisting only of an



Ammeter Control and Ratchet Gear, Johnson & Phillips Prepayment Meter.



Johnson & Phillips Prepayment Meter.

exchange of two-gear wheels. A coin trap is provided on the meter, to safeguard its use as far as possible. It may be mentioned that the clocks are built by Messrs. Johnson & Phillips, and are provided with a slipping device to prevent the possibility of over-winding.

Patent Motor-driven Time Switch.

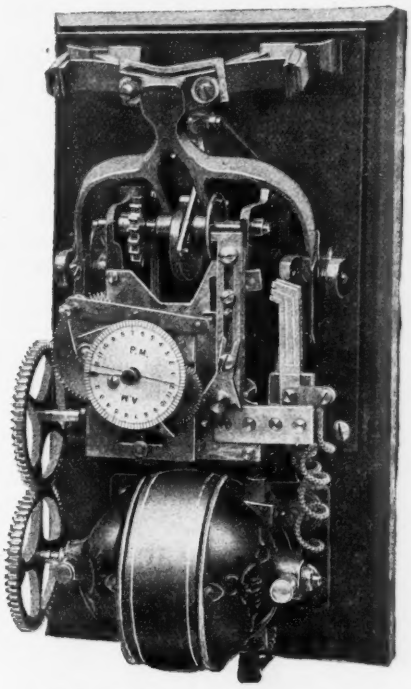
Messrs. Johnson & Phillips have also introduced a novel design of time switch, in which a small motor, controlled by a clock, is employed to actuate the main switch.

The face of the clock is engraved with 24 hours and revolves; behind the face are fitted horns, which are hand-friction tight, and can easily be adjusted to the required positions, and tightened up by means of a screw.

The rotation of the clock causes one of the horns to actuate an auxiliary switch, switching in the motor, which latter by means of wheel and worm gearing closes the main switch, when the motor is cut out. The main switch has a long carbon break, and is capable of carrying 60 amperes.

Further rotation of the clock face results in the other horn switching in the motor, which in turn releases a catch holding the main switch in, and the latter, of course, breaks its circuit, the motor being cut-out as before. The motor runs some seven seconds when making and two seconds when breaking the main switch during these periods it also winds up the clock, which operates continuously.

This clock also is provided with a slipping device to safeguard against overwinding.



Johnson & Phillips Patent Time Switch.

The switch is strongly built and provided with a water-tight cover; we understand that it is successfully employed in operating arc and illuminating device circuits.

PARLIAMENTARY.

Radio-Telegraphic Convention Committee.

On Tuesday, Sir J. Dickson-Poynder's Select Committee resumed its sittings.

Mr. Cuthbert Hall said he wished to give further evidence refuting statements which had been made by previous witnesses. Sir Wm. Preece had commented upon the terms of the agreement between the Marconi Co. and Lloyd's, but he would like to make it clear that the suggestion of the clause for the exclusive use of the Marconi system came from Lloyd's. He thought some of the statements of Sir Wm. Preece were very remarkable. Dealing with the question of the infringement of their patent rights, witness said that the clause in their agreement with the Post Office as to their patent rights fully protected them. It was evident from the decision in the action brought by the Marconi Co. against the De Forest Co. for infringement of their patents, that his company owned the controlling patent. Why they had not been able to stop the De Forest Co. from continuing to make the apparatus was because the patents were being transferred from one company to another, and neither of them had any money, and, as a matter of fact, they had not yet been able to recover their costs in the action from the De Forest Co. If the Government took their patent they would be encouraging a bad policy, and would facilitate the interests of competitors. If their company did agree to intercommunication, it would cause disorganisation and disturbance of their service, and if they did not accept the Convention they would lose foreign ships. The Convention was a skilfully-designed invention for breaking up their monopoly. They did not prosecute companies infringing their patent rights because they were companies which did not seriously affect them.

Mr. Sydney Buxton asked whether it was a fact that the Marconi Co. had been refused another injunction against the De Forest Co. for an infringement of the patent rights, on the grounds that they had ceased to use the "combination patents" for which the Marconi Co. previously obtained an injunction, and witness replied that he was not aware of it.

In answer to Mr. Adkins, Witness said their view was that they were the holders of the controlling patents of wireless telegraphy. Why they did not prosecute Germany for infringing their rights was because it was very difficult to take an action against a Government. The Lodge-Muirhead system was an infringement of their

rights, but they had not taken steps to restrain the company because of the smallness of the company.

Mr. Sydney Buxton: Have you an agreement with the Argentine Government dated August 31st, 1906; and should the Argentine Government sign the Convention, how will that affect your company?—We have a concession from the Government, and should they accept the Convention and the terms of the concession become infringed, we, of course, have the right to withdraw from the agreement. The clause in the Post Office agreement relative to the fact that the Government was to do nothing which would infringe their patent rights, would, as he told the Post Office at the time the agreement was entered into, prevent inter-communication.

Mr. Charles Bright, F.R.S.E., was also called, and said that he considered that wireless telegraphy should be made the subject of international control, as it would ensure better working than if controlled by a private company. If intercommunication were allowed it would break down the present monopoly, and might lead to a reduction in the price of the apparatus and the use of the system. He did not think countries or shipping companies would agree to accept a system that refused to intercommunicate. Witness handed in a letter which he said had been addressed to shipping companies, and he contended that in the light of those letters it was clear that the articles written in the German Press maintaining that the English delegates had not looked after our interests were not spontaneous. He left the Committee to draw their own conclusions.

Mr. Gwynn: Do you suggest that the Marconi Co. inspired this article.—I think the last paragraph in the article is a very remarkable paragraph for a German paper to originate, and I leave you to draw your own inferences.

Replying to Mr. Adkins, Mr. Bright said he was strongly in favour of the Convention.

The Committee adjourned.

Third Reading.—In the House of Commons on May 27th the London and North-Western Railway Bill, and the London United Tramways Bill were read a third time.

In the House of Commons on May 23rd the Lancashire and Yorkshire Railway Bill, the L.C.C. (Tramways and Improvements) Bill, and the West Yorks Tramways Bill, were read a third time.

North Metropolitan Electric Power Supply.—The Metropolitan Electric Supply Co. has withdrawn its opposition to this Bill.

Central London Railway Bill.—It is reported that all opposition to this Bill has been withdrawn.

Electric Lighting Provisional Order (No. 5) **Bill.**—This Bill came on Tuesday before the Examiner for proof of compliance with standing orders and was ordered to be reported to the House. It confirms the following orders: *Minehead and Dunster, Somerset*—Order granted to the Minehead Electric Supply Co. *Rhymney Valley and General Electric Supply Co., Ltd.*—Order issued to this company in respect of Gelligaer, Mynyddislwyn and Bedwellty. *St. Albans and District.*—Order amending the St. Albans Electric Lighting Order, 1898, and the St. Albans Rural Electric Lighting Order, 1905, and allowing the transfer of the orders to the North Metropolitan Electric Power Distribution Co., Ltd.

Electric Lighting Provisional Order (No. 4) **Bill.** — On Tuesday the Examiner had the above Bill before him and found that standing orders had been complied with. The Bill confirms an order granted to George Balfour, of 9, Cloak Lane, Cannon Street, London, electrical engineer, in respect of the burgh of Arbroath.

Electric Lighting Provisional Order (No. 2) **Bill.**—This Bill to confirm a provisional order made by the Board of Trade in regard to the Rural District of Cork came before the Examiner on Tuesday and was ordered to be reported. The order is granted to the Rural District Council.

London Electric Supply Bill.—There was further discussion regarding this Bill in the House of Commons on Monday. The second reading was agreed to, and the Bill was referred to a Hybrid Committee. A motion by Mr. Lloyd-George was agreed to as follows: "That it be an instruction to the Committee that if any power be conferred upon the London County Council to transfer or lease to any company, local authority, body, or person any of the powers, duties, or liabilities entrusted to it by this Bill, the conditions on which such power shall be exercised shall be embodied either in this or a subsequent Bill." This was agreed to.

THE LITERARY ENGINEER.

By A UNIVERSITY LECTURER.

Some superior literary persons deny that technical literature has any claim to literature. Sir Alexander Kennedy recently reminded us of this fact. In his presidential address to the Institution of Civil Engineers, which will be long remembered because of its literary grace, he used the following words:—"Literature, I am afraid, disowns us; I have even heard it denied that the contents of the engineering part of my library could be called 'books' at all in any worthy acceptance of the word. . . . Still, we may claim credit for our technical literature as literature, at least in one respect, that we use words—often inelegantly, no doubt—to express our ideas as clearly as possible." Praise invariably pleases us. If so clever a wielder of the pen is satisfied with the expressions often seen in technical literature, the writer has possibly set himself an ungrateful task. Conscious of his own weakness, he dares to complain that in the crowded curricula of our colleges there is no opportunity given to the engineering student to cultivate the art of essay writing.

Somebody once said that "Poets are born, not made." In a recent interview, Lord Hawke made the same remark about cricketers. Its application to literary work is hackneyed. But surely a man possessing imagination must, with practice, be capable of clear literary expression. The engineer invariably exercises his inventive powers, his patience and his ability for a certain type of constructional effort when engaged upon a design. But he frequently lapses into phraseology full of grammatical errors, when called upon to describe his work. As a rule, clear and forceful expressions are absent from his writings. Technical literature proves that the members of our profession are peculiarly indifferent to the codes of grammar and idiom established by the masters of literature.

Mr. Clarkson, of Chelmsford, is really responsible for these few notes on a subject which has been present in the writer's mind for many months. Sir Alexander's address provided food for reflection. It was Mr. Clarkson who crystallised these thoughts. He recently criticised the literary aspect of a technical paper. He was bold enough to do it in public. He quoted one sentence from a recent contribution to the literature on road locomotion. The author is a well-known consulting engineer. And this is the sentence. "There is no example so instructive in possibilities as the adaptation of the high-grade, high-speed, high-power, light-weight petrol prime-mover to the heavy, arduous, continuous, exacting work of the commercial operation of the motor-omnibus on common roads." The readers of the *Daily Mail* would be delighted with such words. Mr. Clarkson said that he was greatly taken with "the string of adjectives." That sentence will be, in all seriousness, included in the *Proceedings* of an engineering institution. Future generations of engineers will stare stupidly at it. They will be grateful that, in their day, the *Proceedings* are edited.

The writer's art has been defined as "the art of putting sound sense in pure language." It is difficult to acquire. Some of us go through life haunted with the regret that we did not practice the art when young. We should have had fewer misunderstandings; the lawyers would have been less busy. Vagueness and obscurity in the expression of our thoughts cause members of the so-called "learned" professions to look down upon us. Lucidity is the mental lubricant which so many of us lack.

At a recent meeting of the American Society of Civil Engineers, Mr. Bernard Green expressed views worthy of notice. "Engineering literature," he said, "descriptive or critical, of undertakings or accomplished works, or of the experiences of difficult construction, is thin and scarce. Engineers have not written enough, do not write well enough, and do not like to write because they do not know how. That is because of the insufficient training of the past generation that prevented ease and fluency in writing by one intensely engaged in practical work. Consequently, many valuable experiences and ingenious accomplishments, which might have been invaluable to others and to the world, have lived and died in the memories of the engineer geniuses, to whom the labour of concise and readable records was irksome and laborious." Clearness of expression is seldom obtained by the engineer-author. His chief characteristic is the long involved sentence. It is a great misfortune. Author and reader suffer.

The confusion of tenses is a peculiarity at times very noticeable in technical literature. Verbatim reports reveal some pathetic examples. Another peculiarity of the engineer-orator is the remarkable change of the pronouns. The following sentence is an example:—"I say, if you want to standardise, you might as well stay where we are now and use what is here and what is known to be reliable rather

than go to new types as they recommend." Above all else, the engineer-author loves the split infinitive. "To clearly show," is a popular phrase, but he who uses it is a literary hooligan. Metaphors are usually absent from the engineer's manuscript. For metaphors require literary imagination.

One holding a Doctor's degree is guilty of the following gem :—"The thin end of the wedge of competition that has been inserted, has served to awaken considerable dormant energy, the fruit of which cannot be estimated." Confusion of terms is often noticeable when the analogy of the water pipe is used by electrical engineers.

Some young engineers at college may read these few notes. Let the writer humbly advise them to peruse Macaulay, Burke and other classical authors. It is time well spent. They may then get into the habit of writing and speaking good English. It is acquired more readily in the days of our youth. To be able to express thoughts readily and clearly is an advantage which is not understood in early life, but the man who can do so invariably obtains what he wants.

If only subscribers could read all of the contributions which are fired into the room of the editor of a technical paper! They would then have some knowledge of the debt which they owe to that long-suffering individual. Sometimes the alterations which he suggests are acceptable to the engineer-author. Frequently the whole story must be re-written in order that it may march. But he does a good work, this unknown potentate with the blue pencil. Some of our technical literature is pruned in the proof until it is grammatical. When the blue pencil is used more ruthlessly, we shall read really good English in our engineering journals ; and we may then unconsciously get into the habit of writing something less grating to the nerves of the cultured than our usual efforts. The responsibility of the universities in this matter is great. No man should obtain a degree who cannot express himself correctly in his mother tongue. And this of itself seems to be sufficient argument for the thesis, or essay, upon some engineering subject, which the writer dares to advocate. He knows that such an exercise when at college would have assisted him greatly in the painful, and almost despondent efforts which he now makes with tongue and pen. We are all anxious to raise the status of our profession. A future generation will obtain the benefit of our endeavours. Some of us are conscious of the fact that, despite our perseverance, we cannot learn the art of correct literary expression. We are too old. The younger men may commence earlier in life. We trust that they will then succeed.

REVIEWS.

Alternating-Current Motors. By A. S. McAllister, Ph.D. New York : The McGraw Publishing Co. 1906. Price $3.00 net.

Dr. McAllister is to be congratulated on having produced a work of great merit, which will be most useful to students and engineers. He discusses almost every practical type of alternating-current motor. In his preface he states that, in his opinion, much of the difficulty that students experience in understanding alternating-current phenomena is due "to the excessive use of mathematical questions as an end rather than a means. It is believed that mathematics should be employed merely as a shorthand method of stating facts." We must join issue with Dr. McAllister on this point, as it is altogether too low a view to take of mathematics. It may be useful as a shorthand method of stating facts, for instance, $1 + 2 + 3 = 6$, but surely it is also useful in predicting the performance of machines before they are built, or the attenuation of the signals in an Atlantic cable, or in making calculations as to the mechanical and electrical stresses in machines and cables. An easy way of getting applause at the Institution of Electrical Engineers is to sneer at higher mathematics, and to praise common sense—as if the two were divorced from one another. We fancy, for instance, that the common-sense financier attaches considerable importance to the calculations of engineers like Steinmetz, Blondel or Jona in connection with high-tension transmission.

A little further on in his preface the author recovers himself, and we agree entirely with his method, which he states as follows :—"Wherever mathematical equations are employed, the assumptions upon which they are based are definitely stated, and the inaccuracies in the assumptions and limitations in the equations are carefully noted, while the results obtained from the transformed equations are interpreted with due regard to the inaccuracies and limitations."

A book of this nature is of necessity a trifle dull. As a general rule, it is advisable for authors to call attention to the "plums" in their books. The present work may be compared to a good substantial pudding, which cannot possibly be eaten at one meal, and the dainty eater experiences difficulty in finding any plums. When the pudding is finished there is a good deal left on the plate which the reader is not prepared to swallow, but the residue is quite microscopic when compared, for example, to that left after reading some of the theoretical papers written by self-styled "practical men" who have expended large sums of money in developing, sometimes in curious directions, alternating-current motors.

It may be useful to the reader to point out a few minor blemishes—we have not been able to find any major ones—in this book. It may also be useful to the author in view of a second edition—only, we hope he will not forget to put in plums next time.

On page 98 a very primitive formula is given for calculating eddy-current loss. To anyone who does not know the paths of the eddy currents in an iron sheet, the mere statement that the alternation of the flux of induction in the sheet causes "a minute value of E.M.F. which tends to send current through the conducting material of the sheet" can convey no picture of what is happening. Then "this current in its passage through the *sheets*" (the italics are ours) is not the ordinary conception of what happens. In this country the sheets are more or less insulated, and we consider an eddy current as confined to one sheet. We cannot accept the formula given, even although it is multiplied by a coefficient which can be varied to suit the fancy of the engineer. On the same page the "fact" is stated that 1 ampere-turn produces $4\pi/10$ lines per centimetre cube in air. If this were literally true, the calculation of coefficients of self-induction would be as simple as the multiplication table.

On page 99 the "equivalent" network of an ideal transformer is given without proof. Possibly it may be all right, but a much simpler one was published a year or two ago. On page 131 we come across the curious phrase, "cord of angle," for "chord of the angle." We suppose this is Roosevelt spelling. On the same page, when talking about the magnetic field in the air-gap of a polyphase induction motor, it is stated that the space distribution of the flux must be similar to the shape of the applied E.M.F. wave. This is only true when the resistance of the stator windings, and the effects produced by hysteresis, are negligible.

On page 152 it is stated that the "capacity" of an alternating-current generator can be represented by the sides of a polygon—a curious use of the word capacity to denote the effective mesh E.M.F. On page 174 a table is given of the "ratio of effective armature resistance to its true generator value" for polyphase rotaries. After some thinking we found that this meant the ratio of the watts expended in heating the armature, to the watts expended in heating the same armature when only the direct current was flowing in it.

This ratio is the same as that given for a three, four and six rings rotary. For two rings we get 1·38, but the author gives 1·39. He assumes as usual unity power-factor and a 100 per cent. efficiency, but it is just as easy to calculate the values for any power factor and any efficiency. A slight variation in either alters the numbers considerably. The numbers given at the bottom of this page seem to want checking. The reciprocals of 2·66 and 3·76 are given as 0·37 and 0·26, instead of 0·38 and 0·27. A slight arithmetical inaccuracy may seem a small point—but when the mathematical formula is omitted we need to be cautious in

what we swallow. The author has put the reviewer to a considerable amount of trouble to verify his results and to find out what they meant.

The mathematical equations have been carefully checked, but there are four misprints in (145) and (146). On page 204 the mathematical symbol for infinity is placed on its head, and is made to do duty as the symbol for an angle. In this country we prefer to talk about motors in cascade rather than in concatenation or in tandem. The former sounds too like cachinnation to be pleasing to English ears, and the analogy with a chain is somewhat far-fetched.

Turbo-Dynamos und Verwandte Maschinen. By Dr. F. Niethammer. Zurich: Fritz Amberger. Price 10 fr.

Although this book consists of only a few pages of large print, it contains a very large amount of skilfully condensed information on direct and alternate current turbo-dynamo design. To attain this result, the writer assumes a fairly complete acquaintance with the ordinary design problems, and keeps strictly to the discussion of the new difficulties introduced by high-speed working, and even some of these points are partially covered by references to other publications of the author on the subject.

The illustrations are exceptionally numerous and detailed, and often take the place of pages of explanation.

The first 60 pages of the book deal with multiphase alternators under the headings of: Mechanical construction, mechanical stresses and their calculation, electric and magnetic dimensioning, and a useful table of data of some 65 existing single and polyphase alternators and high-speed asynchronous motors is given.

The second part deals with direct-current turbo-generators under the headings of: Commutation, mechanical construction and electrical design, and it includes a table of dimensions of high-speed dynamos and rotary converters.

Ventilation, balancing, noiseless running and testing are also discussed in separate short articles.

In the opinion of the author, although perfectly reliable types of turbo-generators are at present on the market, it would be in the interest of safety of operation and length of life of the electrical portions, if the present high turbine speeds could be reduced by half. He points out that this would involve only a very slight increase in cost, because less expensive material could be used and the cost of labour would be reduced.

The Commercial Organisation of Engineering Factories. By Henry Spencer. London: E. & F. N. Spon, Ltd. 1907. Price 10s. 6d. net.

The importance of system for the control of engineering works will scarcely be contested in these enlightened days, and it is essential that books of reference, setting forth modern practice, should be available for managers and others holding responsible positions in manufacturing concerns.

The work in question covers the ground thoroughly, and a very workable and efficient system is fully detailed by the author. The following points occur to us, however, with regard to the procedure, which might be simplified or altered with advantage:—(1) It would seem advisable to embody a note on the "Outdoor Workmen's Requisition" limiting the value of the goods to, say, 10s., or some such small amount; (2) the usefulness of the "Monogram Rubber Stamp, mentioned on page 27, would be much enhanced if the date were included; (3) special material should not remain in the stores, but be sent at once to the foreman concerned, who should be provided with a lock-up enclosure in which to lay out work waiting to be operated upon; (4) job cards are now often issued from the manager's office to the foremen, with drawings and other instructions, the material cards being sent in duplicate to the storekeeper, who forwards one copy with the material to the foremen; the job cards are suitable for either day or piece-work, and the back of each material card is arranged for the purpose of returning material to the stores when necessary. This system has much to recommend it, as the clerical work of the foremen is thereby greatly reduced; (5) the plan of allowing workmen to book their own time (see time slip, fig. 71), even if initialled by the foreman, is open to abuse; (6) the time for a bonus piecework job runs on until the starting of the next job; surely it is better to clock "off" one job and "on" for the next, thus any waste of time in changing will be shown by the time records and will form a useful indication of the foreman's efficiency; (7) the author advocates "tilting" drawing boards for the draughtsmen. These appliances are more convenient to work upon than the ordinary table, but their use prevents the obtaining of a clear view over the office by the chief draughtsman, and is, therefore, open to objection; (8) With regard to the car specifications index, fig. 48, it would appear advantageous to number each car, and index under these numbers, as the cars are certain to change hands, with resulting delay in tracing the records; (9) The reference numbers consisting of a letter over the drawing number (see fig. 43) might be used for pattern numbers and job numbers with advantage, further, by stamping each part which is not cast, these numbers could be used by customers in ordering replacements; (10) Most of the readers of such works as the treatise under review are in a hurry, and for this reason many passages might have been expressed more simply and at less length.

Apart from the above points, which are none of them vital, Mr. Spencer's book will form a useful guide in organising an engineering factory, and if the procedure he recommends be carried out, success should certainly result.

A SUB-CONTRACTOR'S LIABILITIES.

[From our legal contributor.]

Certain queries and answers which have recently appeared in the columns of the Electrical Review appear to show that the legal position of an electrical firm who undertake a wiring contract, or a contract to erect an electric lighting installation, is not always satisfactory. Assume that he is employed to carry out work in a building which is in the course of erection, it is necessary to inquire whether he is responsible to the builder or the building owner. If he is actually employed by the builder, the question may arise whether he can look to the building owner for payment in case the builder is unable to meet his liabilities; while, on the contrary, he may desire to pursue a remedy against the builder if the financial position of the building owner proves unsound.

Numerous other legal questions may have to be considered in relation to a wiring contractor. One of his workmen is injured in the course of his employment. Who is responsible, the wiring contractor or the person who employs him? A fire takes place in consequence of a short circuit. Is the wiring contractor responsible? There is delay in carrying out the work owing either (*a*) to a default on the part of the wiring contractor; (*b*) to default on the part of those who were to prepare the building or other premises in which the installation was to be laid down. Is the wiring contractor responsible in one case or the other?

It is proposed in the course of the present article to discuss some of these questions in their legal bearing, illustrating them so far as possible by reference to decided cases. While there have not been many decisions relating specifically to wiring contractors, much assistance may be derived from cases which have arisen in relation to building contractors and sub-contractors; for the sub-contractor who undertakes some part of the decoration work required for the completion of a large contract is in a position very similar to that held by a wiring contractor.

(a) Employment of a Wiring Contractor.—Generally speaking, where there is no stipulation against sub-contracting, a contractor may employ sub-contractors. So, if a builder were employed to build a house fitted and ready for electric light, and the contract did not prevent the employment of a wiring contractor, it is apprehended that the necessary sub-contract might be entered into.

A building contract, however, usually contains a clause to the effect that the builder shall not, without the written consent of the employer, employ a sub-contractor for the execution of the works or any part thereof ("Emden's Building Contracts," 4th edition, p. 40). The wiring contractor would, therefore, act prudently in making inquiries as to whether the builder who employs him is authorised to do so by the head contract.

It was held in a Canadian case (Ryan *v.* Willoughby (1900), 31 Can. S.) that where a contract with a municipal corporation provided that the contract should not be sub-let without the consent of the corporation, and the sub-contract contained a clause to the effect that it was made subject to all the terms and conditions of the head contract, it was held incumbent on the contractor to obtain the consent of the corporation before sub-contracting, and if he failed to do so he could not maintain an action against the proposed sub-contractor for not carrying on the portion of the works which he agreed to do. Whether the principle of this case is applicable to the relationship of builder and wiring contractor is a question which is difficult of solution; but at any rate it illustrates the necessity of a wiring contractor making sure of his position.

(b) Remuneration.—The question—who is the sub-contractor to look to for his remuneration—naturally turns upon the conditions of his employment. In the ordinary form of such an agreement (see Emden, *supra.*, p. 400) a clause is inserted providing that the builder will pay to the sub-contractor "the sum of £ when the architect (or engineer) for the time being of the said corporation (*i.e.*, the building owner) shall have certified in writing that the said work has been finished and completed to his satisfaction." Other terms are sometimes inserted providing for payment by instalments.

The question of liability largely depends upon whether the builder was constituted the agent of the employer to employ the sub-contractor or to purchase goods from him, and to establish priority of contract between the employer and such sub-contractor (Emden, *ib.*, p. 40). Where the defendant (a building owner) entered into a contract with a builder, by which the latter agreed to build a house for him under the supervision of an architect, the contract provided that the provisional sums for goods to be ordered from special artists or tradesmen, should, as the architect should certify, be payable by the builder or the building owner. Special goods according to a particular design were ordered by the builder from the plaintiff, who was a metal worker, and the architect certified the sum for these goods as due from the defendant to the plaintiff, deducting the amount from the certificate given to the builder. It was held that the plaintiff was entitled to recover this sum direct from the building owner. In the absence of such a clause, a specialist or sub-contractor would be compelled to look for his remuneration to the person who directly employed him, namely, the builder.

Trouble frequently arises in cases where, owing to the insolvency of the builder, the sub-contractor is compelled to look without success to the building owner. By means of a special clause this difficulty may be obviated. So in *in re* Wilkinson, *ex parte* Fowler ((1905) 2 K.B.) a district council entered into a contract with a contractor for the construction of certain sewage works. The contract provided that certain machinery for the works was to be supplied to the contractor by certain specified firms, and that "if the engineer shall have reasonable cause to believe that the contractor is unduly delaying proper payment to the firms supplying the machinery, he shall have power if he thinks fit to order direct payment to them." The contractor having become bankrupt, it was held that the engineer had power to direct the payments to be made to the machinery firms direct. Mr. Justice Bigham said: "I think the clause means that if the persons supplying machinery to the contractor for the purpose of the contract are not promptly and properly paid by him, they can apply to the engineer, and then it shall be competent for the engineer to intervene, and by a proper certificate given in that behalf to require the Council to pay to the machinery firms the amount of their accounts directly—that is to say, not through the hands of the contractor at all, but the money is to be paid directly by the Council to the machinery firms." A little combination on the part of wiring contractors might have effect to secure the insertion of some such clause in their contracts.

(c) Liabilities for (i) Delay.—If an employer reserves to himself the right of employing specialists to do any portion of the work on a large contract, he does not thereby give any implied undertaking to the head contractor that he will be responsible for any damage caused to the builder by any delay or default on the part of the specialists. In the case of Mitchell *v.* Guildford Union (68 J.P. 54), a builder undertook to do the whole of a certain piece of work for a certain sum, but part of it was to be done by specialists. The builder undertook to finish the work by a certain date unless he was hindered by (*inter alia*) delay on the part of the engineers or other specialists. The builder was not to be liable for any defects in works provided by the specialists, unless by the reason of contributory negligence on his part, or his having paid any final balance to the specialists without first having the architect's written authority to do so. In the course of the work there was delay on the part of the specialists whereby the builder suffered damage. The builder brought an action for breach of contract against the building owners, alleging that under the contract and specification there was an implied promise on the part of the building owners that the delivering and pricing should be done at such reasonable times as to enable the builder to complete his work within a reasonable time thereafter, and that the building owners had broken one or both of these implied promises. It was held that on the proper construction of the contract and specification there was no such implied promise, and that there was no breach of contract on the part of the building owners affording the builder a right to damages. As a general rule, however, the sub-contract contains a clause to the effect that "the sub-contractor shall pay to the contractor the sum of £ as liquidated damages, and not by way of penalty, per day for each day after the day of that the work shall not be finished or complete, and it shall be lawful for the said contractor to retain the said sums out of any money payable to the sub-contractor."

(ii) Negligence.—The liability of a sub-contractor for negligence in carrying out his work, or for damages which are caused as a result of that negligence, is very similar to the liability of a head contractor. Indeed, this part of our subject might be considered wholly apart from the question of sub-contracts. As a general rule the contractor insists upon the insertion of an indemnity clause. The effect of such a clause will be presently considered.

When a contractor is employed to do a specified piece of work, and, even after the lapse of some time, damage is occasioned through his negligent omission, he may be held liable. So a wiring contractor might be held responsible for a short circuit which was caused by his faulty workmanship. In a Scotch case the stock in a shop having been injured by an overflow of water from a house above, the proprietor of the house, who had been found liable for the damage caused, sued a plumber who had been employed by him to alter and repair the pipes in the house four years before the overflow, for repayment of the sum of damages and expenses paid by him, in respect that the overflow had been occasioned through his insufficient and defective plumber work. It having been proved that the flow was due to an imperfectly secured pipe, the plumber was liable for the expense to which his employer had been put.

Before deciding whether a wiring contractor is liable, strict regard must be had to the terms of his employment. In a recent case, Fulham Borough Council *v.* National Electric Co. (1906) 70, J.P. 55, a contract for the installation of electric light in a building to be used for the purposes of public baths and wash-houses provided (*inter alia*) that "That the whole of the work is to be carried out in accordance with the existing rules as framed by the Phœnix Fire Office . . . . ." Rule 5 of these rules provided that "Where a system of metal tubes is employed, the metal tubes should be earthed, except in those cases where earthing would not be desirable."

A system of metal tubes was employed in the work, and, in consequence of such tubes not being earthed, a bather received an electric shock which caused his death. The local authority, which owned the baths, paid damages in respect of his death. In arbitration proceedings, in which the local authority sought to recover the sum so paid from the contractors, the arbitrator found that earthing the tubes would not have been desirable so far as risk of fire was concerned, but would, in fact, have been desirable so far as risk of accident to bathers was concerned. It was held, upon the hearing of a special case stated by the arbitrator, that inasmuch as the insurance company's rules were framed for the prevention of fire, and earthing was not desirable for that purpose, there had been no breach of contract, and that, therefore, the wiring contractors were not liable.

(iii) Workmen's Compensation.—Questions of great and increasing importance arise in relation to the liabilities of contractors and sub-contractors under the Workmen's Compensation Acts. It is manifest that, in a case where a wiring contractor employs men upon a big job, he is exposed to a very serious risk. His men must often climb to dizzy heights in carrying out their work, and it is important to reflect that the wiring contractor has in general no power or authority to take any step which will minimise the risk of accidents.

The necessity for his entering into some definite arrangement with the head contractor was illustrated in a very recent case (Greenwood *v.* Hawkins, 23 T.L.R., 72). There a builder agreed to employ a sub-contractor to do the carving. The written order which constituted the contract, concluded: "You agree in accepting this order to sign and send per return of post the enclosed accident indemnity." The document in question was to hold the builder harmless against all claims under the Workmen's Compensation Act, 1897, by any person in the defendant's employment upon such work in respect of any accident. The defendant did not return any answer to the order, nor did he sign the indemnity form, but he went on with the work. An accident happened to a workman employed by him upon the work for which the contractor had to pay compensation under the Act of 1897. The contractor claimed indemnity from the defendant. It was held that the defendant executed the work upon the footing of the order given to him by the contractor and of the indemnity enclosed with it, and that he was liable to indemnify the contractor.

It may be mentioned, in this connection, that by Sec. 4 (1) of the Workmen's Compensation Act, 1906, which is to come into force in July, 1907, while liability is expressly placed upon the head contractor where there is a sub-contract, nothing in the section is to be construed so as to prevent a workman recovering compensation under the Act from his immediate, instead of his more remote, employer. Further, the principle of indemnity is recognised in sub-Sec. (2).

BUSINESS NOTES.

Dissolutions and Liquidations.—NATAL COPPER SYNDICATE, LTD.—This company is winding up voluntarily, with Mr. R. F. Masterton as liquidator.

SINGOPHONES, LTD.—Creditors are to send particulars of their debts, &c., to E. C. Pegler, 60, Watling Street, E.C., the liquidator, by June 22nd.

BUCHHOLTZ REVERSIBLE TURBINE SYNDICATE, LTD.—This company is winding up voluntarily, with Mr. G. Noble, 32, Poultry, E.C., as liquidator. Mr. John Ward, of 4, Bennett Street, St. James's, S.W., has been appointed as receiver on behalf of the debenture-holder.

IMPROVED ELECTRIC SUPPLIES, LTD.—First meetings of creditors and contributories are to be held on June 18th, at Bankruptcy Buildings, Carey Street, W.C.

MCGUIRE MANUFACTURING CO., LTD.—The *London Gazette* notifies the release of liquidator (F. W. Pixley, 58, Coleman Street, E.C.) on April 15th.

Book Notices.—"Armature Construction." By H. M. Hobart and A. G. Ellis. London: Whittaker & Co. 1907. 15s. net.

"Essais des Machines à Courant Continu et Alternatif." By P. Bourguignon. Paris et Liége: Ch. Béranger. 1907.

"The Progress of Electrical Enterprise." By E. Garcke, M.I.E.E. London: The Electrical Press, Ltd. 1s. net.

"Dynamo and Motor Attendants and Their Machines." By F. Broadbent, M.I.E.E. Fifth edition. London: S. Rentell and Co., Ltd. 1s. 6d. net.

Brush Contracts.—The following contracts have been placed with THE BRUSH ELECTRICAL ENGINEERING CO., LTD.:—

For the Kidderminster Electric Lighting and Traction Co.—500-kw. Brush steam engine and dynamo.
For Belfast Corporation tramways.—25 Brush single trucks.

Surface Condensing Plant.—MESSRS. WILLANS AND ROBINSON, LTD., of Rugby, have recently received orders for their surface condensing plant as follows:—

Two complete sets to condense 20,000 lb. of steam each per hour, for the Wolverhamption Corporation.
One set to condense 20,000 lb. of steam per hour, for the Dublin United Tramways (1902) Co.
One set to condense 20,000 lb. of steam per hour, for the Cheltenham Corporation.

These orders bring the total number of Willans surface condensers built during the past two years up to 53, representing about 1¼ million lb. of steam to be condensed per hour.

Catalogues and Lists.—THE BRITISH THOMSON-HOUSTON CO., LTD., Rugby.—Illustrated pamphlet No. 203, describing their continuous and alternating current fan motors and exhaust fans.

MESSRS. MATHER & PLATT, LTD., Salford.—Large stout show-card, illustrating photo-process blocks of some of their various electrical and engineering manufactures—generators, motors, turbine pumps, electric locomotives, turbo-generators, gas engines, &c. A view of the main erecting shop at the new works occupies a central position.

MESSRS. J. C. LYELL & CO., LTD., 55, Victoria Street, Westminster.—Four-page illustrated publication giving particulars of the new "Verdol" accumulators, which they have just introduced into this country, and for which they are sole British agents. Several novel points are claimed in the construction of the accumulator. The plates present a very large active surface, and are claimed to stand very rapid charging or discharging without "buckling" or the paste crumbling or falling out of the grids, and they are free from consequent "short-circuiting." They are further claimed to show a very great saving in size and weight as compared with other makes of a similar capacity. The "Verdol" batteries, together with a number of other electrical and automobile novelties, are being exhibited at the "Travel" Exhibition, Horticultural Hall, Vincent Square, Westminster, which is to close on June 8th. Prices are given of ignition accumulators for automobiles and explosion engines, also compound accumulators.

BRITISH INSULATED AND HELSBY CABLES, LTD., Prescot.—Twenty-four page brochure giving excellent illustrations, descriptive matter and tabulated sizes and prices, of their Prescot noiseless paper pinions.

MESSRS. BRUCE PEEBLES & CO., LTD., London.—Finely illustrated show-sheet, illustrating some of the finer examples of electric power plant put down by them. Photographic half-tone views are given of the Durham Collieries turbo-alternator power station, the North Wales power station, motor-converter plant of the Great Western Railway, colliery electrical equipments, also of an aisle in the East Pilton works of the company. This sheet has been specially prepared for hanging in the showrooms of electricity supply and like concerns.

UNION ELECTRIC CO., LTD., Park Street, Southwark, S.E.—Illustrated list No. 1,362 just issued giving information, prices, &c., of the "Union" pure carbon arc lamps for photographic work, also copying and printing enclosed arc lamps (direct current), and copying and printing lamps differentially wound with open arc and parabolic reflector. The company have done a good deal in the way of photographic arc lamps for various classes of work, as a result of which they have now issued this list of their standard patterns.

THE ELECTRICAL CO., LTD., Charing Cross Road, W.C.—New leaflet No. 239, giving prices of several types of "Imperial" continuous-current fans.

MESSRS. E. A. G. v. KOLBEN & CO., 20, Budge Row, E.C.—Pamphlet No. 51, giving full and illustrated description of their searchlight projectors.

Trade Announcements.—THE VINCIT CO., LTD., of 117B, Queen Victoria Street, E.C., have been recently appointed the sole agents in Great Britain, Ireland and the Colonies, for the Vienna Carborundum Works, manufacturers of carborundum and "Electrite." The latter is a new production from the electric furnace, having certain qualities not possessed by carborundum, which makes it a more ideal abrasive for the production of grinding wheels, &c. The Vincit Co. hold a large stock of both carborundum and "Electrite" cloth, paper, wheels, grain, powder and files. We have received a 24-page pamphlet relating to the specialities.

MESSRS. ROYCE, LTD., of Trafford Park, have appointed Mr. C. S. Mallett to represent them in the London and south-east country district. Mr. Mallett, who has had a life-long experience of electrical engineering, for some years occupied the position of works manager of the company's electrical works, and later acted as its purchasing agent. He is fully conversant with the latest practice as regards the construction and installation of electrical generating plant of all types, motor driving, &c., and the construction and installation of electrically-driven cranes and lifting appliances, transporters, capstans and other labour-saving devices. His address, *pro tem.*, is 7, Queen's Gardens, Tetherdown, Muswell Hill, London, N.

MR. ASHBY W. WARNER, A.I.Mech.E., of Norton, near Stockton-on-Tees, has recently been admitted into partnership in the firm of A. Haacke & Co., the well-known boiler and pipe coverers, &c., Mr. Warner has had 16 years as manager of this firm in London Glasgow and West Hartlepool. It is intended to turn the firm into a limited company during the present year, but probably there will be no public issue of the shares.

Bankruptcy Proceedings.—F. WILLIAMS.—Francis Williams, electrician, 17, Orchard Road, Bemerton, Salisbury, whose statement of accounts appeared in the ELECTRICAL REVIEW last week, was examined at Salisbury on May 23rd. Debtor stated that he commenced business in 1901 with a borrowed capital of £16. He did the free wiring for the Salisbury E.L. Co., he finding the material and labour, and being paid so much per light; 18 months ago the arrangement ceased, and since then he had found a difficulty to make both ends meet. He added that he had had bad luck with his wire, which was breaking down all over the city. He paid top price for it, and through it going wrong his reputation had been injured. The examination was closed.

G. & J. S. ROBSON (Robson, Robson & Co., electrical engineers, Newgate Street, Newcastle-on-Tyne).—June 13th is the last day for receipt of proofs for intended dividend. Trustee, T. Leman, 1, St. Peter's Church Walk, Nottingham.

An Electrical Development Creed.—Prizes aggregating $250 have been offered by the Co-operative Electrical Development Association of America, to whose work we have on several occasions made extended reference, for the composition of the "Electrical Co-operator's Creed." The object is to give the best possible brief expression to the idea and purpose of the Association. The first prize is $100; second, $50; third, $25; and there are three of $15 and three of $10. Competition is restricted to men interested directly or indirectly in the electrical business. The winning compositions will be printed in pamphlet form and distributed at the Washington convention of the National Electric Light Association next week. According to the *Western Electrician* the following is a "Credo" by Mr. E. O. Grover, which is given as suggesting the character of composition wanted:—

"I believe in the goods I am selling, in the firm I am working for, and in my ability to get results. I believe that honest goods can be sold to honest men by honest methods. I believe in working, not waiting, in laughing, not weeping, in boosting, not knocking, and in the pleasure of selling goods. I believe that a man gets what he goes after, that one order to-day is worth two orders to-morrow, and that no man is down and out until he has lost faith in himself. I believe in to-day and the work I am doing, in to-morrow, and the work I hope to do, and in the sure reward which the future holds. I believe in courtesy, in kindness, in generosity, in good cheer, in friendship, and honest competition. I believe there is an order somewhere for every man ready to take one. I believe I'm ready right now."

LIGHTING and POWER NOTES.

Abram.—The U.D.C. on May 22nd sealed an agreement for the transfer of the E.L. order to the Lancashire Electric Power Co.

Barking.—A L.G.B. inquiry was held on the 27th inst., into the Council's application for sanction to the borrowing of £1,500 for electrical extensions; the application was opposed by the Ratepayers' Association. The extension will enable the Council to supply a manufacturing firm which has agreed to take 100,000 units per annum.

Birmingham.—The accounts of the electricity department for the year show that the total number of units sold amounted to 10,887,684, and the money value £103,341, compared with 5,383,904 units and £75,094 respectively in the previous year. Of the total number of units 7,009,602 were for lighting and power (excluding tramway supply), and 3,878,082 for tramway supply. The revenue account shows a credit balance of £54,411, against £41,457 in the previous year. After payment of interest and sinking fund charges amounting to £46,698, the net surplus profit amounts to £7,713, against £6,097 in the previous year. Taking into account the heavy interest and sinking fund charges on capital expenditure, a large part of which became remunerative only from January last, the Committee regard the result as a satisfactory one. During the year works costs have fallen from 1·45d. to 1·06d. per unit, due to the more efficient working with the Summer Lane station. The net increase in lamp and motor connections during the year equalled 63,019 16-C.P. lamps, and included 2,570 H.P. in motors connected. The total number of 16-C.P. lamps or their equivalents now connected amounts to 211,843, in which is included 6,006 H.P. of motors.

Brighouse.—The T.C. has appointed a Committee to complete negotiations with the Yorkshire Electric Power Co. for a supply of electricity in bulk.

Carmarthen.—The T.C. has submitted the E.L. scheme prepared by Messrs. J. B. Saunders & Co., Cardiff, to Messrs. Medhurst & Lloyd, for their report, before signing a 14 years' contract with the firm. The maximum price for lighting is to be 5d. per unit, and for power the charge is to be 2½d. or 3d. per unit. Overhead wires are to be used.

Cambridge.—The C.C. has been recommended to put down a producer gas and E.L. plant at Fulbourn Asylum at a cost of £7,000.

Clacton.—The first 10 months' working of the Council's electricity undertaking has resulted in a loss of £800; this, however, is less than was estimated.

Continental Notes.—AUSTRIA.—At the end of 1905, the number of generating stations in operation amounted to 446, furnishing supplies to 1,087 localities. During 1906 45 new works were erected, bring up the total to 491 concerns; the total plant capacity was approximately 169,000 KW. In 126 works the pressure exceeded 1,000 volts, and usually varied from 2,000 volts to 3,000 volts.

Clonakilty (Ireland).—At a meeting of the Lighting Committee of this town last week, Mr. J. O'Sullivan presiding, estimates were received for lighting the town by electricity and oil gas. The electric lighting scheme involved a sum of £2,750 (including dynamos, switchboard, cables, meters, buildings, &c.), and with 500 25-C.P. lights and public lighting, the receipts were calculated at £670, and the expenditure at £528. With the other illuminant, the capital expenditure was estimated at £3,500, the receipts at £350, and the expenditure at £280 per annum.

Denny.—The Council, along with Mr. J. A. Donachie, electrical engineer, of Coatbridge, has adjusted the terms of the agreement with the Scottish Central Electric Power Co.

Dublin.—The E.L. Committee is proceeding with the work of installing electric incandescent lamps in place of gas lamps on O'Connell, Grattan and Butt Bridges, and around the statues throughout the city. The alterations are being carried out by the Corporation Electricity Department, and Osram lamps are being installed.

Dundee.—The Committee, acting on the advice of Mr. Richardson, the electrical engineer, has agreed that the cost of energy for heating, cooking, &c., which has been previously 2d. per unit, shall be reduced to 1½d. per unit. The following graduated system of charging for lighting has also been adopted:—For each unit in the first 2,500 units per quarter, 3½d. per unit; second 2,000, 3d. per unit; third 2,500, 2¾d. per unit; fourth 2,500, 2½d. per unit; fifth 2,500, 2¼d. per unit; and all units in excess of 12,500, 2d. per unit. A sub-committee has also been appointed to take into consideration each special application for power in bulk, and to discuss with Mr. Richardson as to the right price to be charged in each case.

Eastbourne.—Mr. R. H. Birkwell will hold an inquiry on July 4th, into this Corporation's application to the L.G.B. for sanction to borrow £9,934 for extension of plant at the electricity station.

Gravesend.—A L.G.B. inquiry was held on May 21st into the application of the T.C. for a loan of £9,500 for electricity purposes. There was considerable opposition, four members of the Town Council opposing.

Hanley.—The electricity department's returns for the year ending December 31st last, show a revenue of £15,252 as compared with £14,738 in 1905. The total working cost amounted to £7,587 (or 1·65d. per unit), and including financial costs, the commercial costs amounted to £13,094, or 2·85d. per unit, the surplus for the year being £2,158, which compares with £1,449 in 1905. Some 1,102,194 units were sold during the year, an increase of 21 per cent., the supply including energy to 392 H.P. of motors.

India.—CALCUTTA.—Two Bombay firms, Messrs. Killick, Nixon & Co. and Messrs. John Fleming & Co., have secured a license from the Bengal Government for the generation and supply of electric energy to the Hooghly River district of Bengal, that is, the west bank of the river, which is crowded with important mills.

Kilmacolm (Renfrewshire).—The E.L. undertaking has now been at work for 3½ years, and is making very satisfactory progress. The supply is entirely a domestic one, the district being one of the principal health resorts in Scotland; some 150 consumers are coupled to the supply mains, and 20 others are to be connected. Cables are laid on all existing roads, and the contract for cables for new roads has been placed with Messrs. Callender's Cable and Construction Co. An extension to the generating plant at the works is at present under consideration.

Kirkcaldy.—During the past financial year the local electrical undertaking supplied 625,000 units for traction, 100,000 for public lighting, and 300,000 for private lighting and power purposes. The undertaking is making headway with large consumers, the Dunnikier Collieries, recently connected, requiring 450,000 units per annum, and a similar quantity being estimated as the requirements of two other consumers.

Lancaster.—The income for the year is reported to be £9,354, as against £9,203 in 1905-6, while the expenditure is £808 more than last year. The net profits are £369 14s., against £1,018 last year, and this sum has been carried to the reserve fund. The sale of energy for lighting shows an increase of 3·34 per cent., but only £73 more was received, owing to the recent reduction in price. The sale of current for motive power increased by 48 per cent., but £159 less was received from tramways.

New Zealand.—CHRISTCHURCH.—The City Council, after considering the generation of electricity by steam, suction gas, and water power, has decided to adopt the latter plan. The estimated cost of the plant, &c., is £133,642, and the annual working cost £15,435.

South Shields.—As a result of the past year's working of the Corporation electricity undertaking, a net profit of £3,200 is reported, after meeting the charges for interest and sinking fund. This is the largest surplus since the inauguration of the concern above ten years ago.

Walthamstow.—At the meeting of the Council on Friday, the electrical engineer reported that, at the recent inquiry, held by Mr. H. R. Hooper, as to the application for sanction to borrow £26,395 for additional plant, the inquiry was adjourned to give the Council an opportunity of reconsidering its application, with a view to reducing the plant to be provided. The electrical engineer stated that he had prepared an amended scheme, under which the application for sanction to borrow would be reduced to £17,349, made up as follows: Boiler house plant, £7,480; chimney, £856; engines and dynamos, £3,938; condensing plant, £2,270; switchboard, £604; water-softening and purifying plant, £425; foundations, £180; new buildings, alterations and foundations for boilers, chimney and pumps, £1,174; contingencies, £250; loan charges, £172. In future all power consumers are to be allowed for lighting purposes at power rates a number of units equivalent to 20 per cent. of the amount annually used for power. This is to take effect from December 1st last. The question of extending the electric lighting to Highams Park is still under consideration, as is also the matter of improving the lighting at the Wood Street end of the Upper Walthamstow Road.

Western Australia.—PERTH.—The Municipal Council is considering the advisability of commencing the supply of electricity in competition with the Perth Gas Co., holding that the price asked by the latter for its electrical undertaking (£400,000) is excessive. Mr. Wall, of Messrs. Splatt, Wall & Co., who in 1901 advised the Council not to supply electricity, now recommends this step, in view of the reduced cost of plant and the increased demand for electricity. The Council is advertising for an engineer to prepare and carry out a scheme, and generally to advise in the matter.

Whaley Bridge.—A private firm has submitted an E.L. scheme to the U.D.C.

TRAMWAY and RAILWAY NOTES.

Belfast.—At the adjourned meeting of the Tramways and Electrical Committees on the 27th inst., Sir Robert Anderson presiding, Mr. Nance, the manager, reported that the working expenses of the proposed extension through Ligoneil would amount to at least £2,000 per annum. Considerable levelling would have to be made in the gradients, and permission would have to be obtained to go on private property to evade some of the steeper ones. The matter was eventually postponed. The people of the Donegall Road, an extensive working-class suburb, are also agitating for an extension of the tramway in that locality.

Birmingham.—The gross profit for the last year's working of the tramways amounts to £52,343, and, after payment of interest and sinking fund and other charges, there remains a net profit of £26,660. The Committee proposes to place £14,660 to reserve, and to carry the balance of £12,000 to the borough fund in reduction of rates. The receipts include a full year's operation of the Aston route, but only three months of the more extensive lines now worked by the Corporation.

Blackpool.—The returns of the Corporation's tramway undertaking for the past year show that 958,836 car-miles were run, and 8,304,218 passengers carried during the 12 months. The revenue amounted to £56,586, working expenses were £31,605, and after meeting financial charges there remained a balance of £10,042. The latter sum was allocated as to £4,000 to the rates, £2,042 to reserve, and £4,000 to renewals. The revenue per car-mile amounted to 14·16d. The traffic is, of course, a season one, and it is interesting to note that it varied from £3,500 per week in August, 1906, to £300 per week in January, 1907.

Bombay.—A correspondent writes that after many delays, the first portion of the new electric tramway service was opened on Tuesday, May 7th, in the presence of the Municipal Commissioners and officials. The service appears as if it will meet with great success and become very popular. The first two days were marred by accidents resulting in loss of life, due in both cases to what might be said to be the fault of the tramway company. The cars are mounted on two bogies, and being exceptionally long are provided with side entrances in the centre of the car as well as rear entrances. These entrances are protected only by a light brass chain, which offers but little resistance to anyone desirous of boarding a car.

The first accident occurred through a native boarding the car from the wrong side and fouling one of the centre posts as the car

passed; and the second through a native slipping whilst boarding a car in motion. Both accidents consisted in the person's legs being run over by the rear bogie.

One feature of which engineers are watching the results with interest, is the method of laying the track. Departing from the almost standard town and city method of laying on concrete, the rails in Bombay are laid on sleepers which are bedded on road metalling rammed dry, and then the whole is covered in with ordinary road metal to the rail level. Many people fear that the sleepers will not last any length of time, and that ants and climatic conditions will rot them rapidly. India is a country where usually timber in any construction is avoided as much as possible, and to choose it in tramway permanent way appears to be a risky experiment.

The other sections of the tramways are well in hand, and a few months should see most of Bombay accessible by means of electric traction.

Continental Notes.—GERMANY.—The electric mountain railway known as the Gerardmer or Géromé ravine on the French side of the Vosges, which has been in existence for several years, has now been complemented by the opening to traffic of the Munster Gorge railway, which is situated on the German side of the mountain range, the summit of which forms the frontier line between the two countries. The rise from the level ground to the summit amounts to 1,139 metres, and two schemes were first taken into consideration. The first was for an adhesion electric railway of metre-gauge of a total length of 14½ km. (9·9 miles), and the second for a combined metre-gauge rack and adhesion railway of a length of 10·8 km. (6·6 miles). It was decided to adopt the latter combination; the preliminary work was commenced in September, 1905, and the first trials were begun last November. The cost of construction has amounted to £67,500, and the Alsace-Lorraine State granted a subsidy of £1,000 per kilometre to the private company which owns the railway. A technical innovation is claimed for the motor-cars, which are each equipped with two adhesion motors and two rack rail motors. The adhesion motors only are used on the sections of the line worked by adhesion, whilst on the rack sections all four motors are requisitioned, the rack-rail motors having a double system of transmission, and the adhesion motors being placed in series. All four motors are operated by a single controller, and are arranged for working in series and in parallel, for advancing and reversing, and for electric braking. The combination is termed the Strub patent, and it has been carried out by the contractors, the Alioth Electricity Co., of Munchenstein-Basle. The supply of electricity is obtained from a power station at Munster, which serves that town and environs, and where car-sheds and repairing shops are also situated. Polyphase current is transmitted, for the working of the railway, to a sub-station 3·7 miles distant, equipped with two rotary converters and an equalising battery of 390 cells, having a capacity of 296 ampere-hours. The inauguration of the railway, which took place on May 13th, was attended by numerous representatives of the Government and Civil authorities, and of the French mountain railway on the other side of the mountain chain. The journey on the railway occupies one hour, and nine trains daily are in service, although it will be possible to increase this number to 15 in each direction.

ITALY.—H.M. Consul reports that the Genoa Electric Tramway Co. propose to construct three "secondary" electric traction lines to Pontedecimo, Sestri Levante (to be extended later to Chiavari) and Voltri, on private roadways, *i.e.*, without using the public roads except at crossings. This would permit of a speed impossible on public roads, and relieve some of the railway passenger traffic in the immediate neighbourhood of Genoa. The company estimate the cost at £2,000,000.

The Consul also reports that some capitalists at Milan and Savona have formed a company for setting up electric power works in the valley of Albenga, with a view to supplying the principal industries, and eventually a tramway service along the Western Riviera, with electric motive power. Several of the more important iron and steel works have promised their support to the undertaking.—*Board of Trade Journal.*

Croydon.—It is understood that the agreement for the running of through tramcars between Croydon, Penge and the Crystal Palace has been signed. It will take effect as soon as certain necessary arrangements are complete. The Croydon Corporation will provide the cars to run between Croydon and the Penge terminus, and the South Metropolitan Tramways Co. will supply the cars for service between Croydon and the Crystal Palace (high level).

Dundee.—The burgh engineer has been instructed to prepare plans and specifications for the extension of the electric tramways to Downfield, a district lately annexed by the town. In the city itself there is to be an extension down Union Street.

Halifax.—The Corporation Tramways Committee during the year ended March 31st expended £79,683, the expenditure per car-mile being 11·774d. The total income for the year was £77,995, and there is thus a loss of £1,687, against a profit of £3,201 in the previous year. The North Bridge tramcar disaster in July last year cost £2,300 in compensation claims, and of this sum only £1,000 is covered by insurance. A considerable portion of the deficient income is attributed to the strike.

Holmfield and Southowram.—The promoters of the Holmfield and Southowram Light Railway have applied to the B. of T. for an extension of time for carrying out the scheme.

Lancaster.—The number of passengers carried last year was 1,353,681, against 1,482,820 in the previous year, the reduction being due to a boycott of the cars following the abolition of halfpenny stages. The cars ran 194,577 miles, against 213,277 miles, the receipts being 6·61d. per car-mile against 5·89d. The receipts amounted to £5,361 for traffic. The borough accountant recommends that provision for depreciation should be made. Up to the present the gross loss on the tramways is £14,128, the deficit for the year being £2,836, against £3,143 in the previous 12 months.

London.—STOKE NEWINGTON.—The B.C. has been informed that the Highways Committee of the L.C.C. is considering, in connection with the proposal to have through tickets between the Middlesex and London electric tramway systems, the possibility of arranging with the Metropolitan Electric Tramways for the Council's cars on the Kingsland Road route to run as far north as Seven Sister's Corner, instead of only to Stamford Hill, as at present.

Middlesex.—£1,500 has been placed at the disposal of the county engineer for the purpose of engaging temporary assistance during the next six months in connection with light railway schemes.

Newcastle-on-Tyne.—The accounts for the past year of the Corporation tramways undertaking have just been completed, and these show that the net profit on last year's working has been £28,000, against £26,000, as estimated. Of the former sum, £12,000 has been given to the relief of the rates, leaving £15,000, which, it is expected, will be carried to the depreciation fund.

New Zealand.—WELLINGTON.—The year's working of the tramways resulted in a net profit of £14,300. The total receipts were £96,600, working expenditure £62,456, and financial charges £19,770. It is proposed to devote £10,500 to depreciation.

South America.—MONTE VIDEO.—The Trans-Atlantic Tramway Co. of Monte Video will shortly inaugurate a section of its electrical system running from the Centre to Paso del Molino. The complete system of the company will not be ready for traffic before August or September next.

The Sociedad Comercial de Monte Video will shortly inaugurate the electric tramway line from Buceo to Union, city of Monte Video. The London board of this company has been asked for permission to extend the Punta Carreta branch as far as the lighthouse.—*Review of the River Plate.*

ROSARIO.—It is rumoured that the undertaking of the Rosario Electric Tramway Co. is shortly to be transferred to the Compania Alemana Transatlantica de Electricidad.

Spen Valley.—The Cleckheaton U.D.C. has protested to the B. of T. against the granting of a further 12 months' extension of time to the Yorkshire (Woollen District) Tramways Co. for the completion of their undertaking in the Spen Valley. It is pointed out that several previous extensions have been granted. The application is also being opposed by the Liversedge U.D.C.

Walthamstow.—The tramways manager has been informed that the policy of the Council is that the tramways should be self-supporting, if not profitable, and that the inhabitants of Walthamstow only should, as far as possible, enjoy the benefits of the lowest possible fares; the manager has been directed to prepare a scheme which will, either by increasing fares or by economies of administration, or by both methods, carry out this policy.

TELEGRAPH and TELEPHONE NOTES.

Italian Telephones.—The Postmaster-General has presented to Parliament his scheme for the acquisition of the telephone service by the State on July 1st. The Italian telephones are at present in the hands of 74 different companies, and the Government has already arranged to purchase the principal urban telephone systems for a little over £610,000. The price in Rome is about £6 15s. per annum for the ordinary subscriber.—*Morning Post.*

Telegraphic Interruptions and Repairs:—

CABLES.		INTERRUPTED.	REPAIRED.
Cayenne-Pinheiro		Aug. 18, 1902 ..	..
Curacao-Coro			
Curacao-La Guayra	Closed..	Jan. 12, 1906 ..	..
Curacao-Maracaibo			
Reissa-Issa and Reissa-Yemani (Yemen)		Oct. 22, 1902 ..	..
Tarifa-Tangier		Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)		Mar. 9, 1904 ..	..
Garachico-Santa Cruz		July 12, 1906 ..	..
Las Palmas-Arecife		Aug. 18, 1906 ..	..
Dakar-Conakry		April 24, 1907 ..	May 22.
LANDLINES.			
Puerto-Barrios		Aug. 2, 1903 ..	..

Telephone Users' Association.—A movement is on foot to form a Telephone Users' Protection Association in London, with a view to remedying alleged grievances and obtaining a better service. Mr. H. Friend, of 90, Bucklersbury, is promoting the movement.

CONTRACTORS' COLUMN.

Openings for new Business.

ACCRINGTON.—Works for Mr. Walter Phillips. Henry Ross, architects, Cannon Street, Accrington.

BARNET.—Residence (£1,900). White, Son & Pill, High Street, Barnet, architects.

BOLTON.—Additions to mills for Messrs. Poole, Wigan Road.

Doubling mill for J. Crook & Sons, Deane Road Mills.

BOURNEMOUTH.—Science and Art School, including electrical testing room and electrical laboratory, to be built (£25,000).

BURSLEM (Cobridge).—Extension of works for Henry Alcock & Co., Ltd. H. Burgess, architect, Stafford Street, Longton.

CARDIFF (Fochriw).—New church and institute. R. E. Douglas, architect, London; Williams & Sons, builders, New Tredegar.

CARLISLE.—Factory. M. Johnstone, architect, Carlisle; owners, R. R. Buck & Sons.

CASTLEFORD (Yorks).—New secondary schools (£12,000). Robinson and Jones, architects, Leeds.

CHELMSFORD.—New Post Office. Secretary, H.M. Office of Works, Storey's Gate, S.W.

CLECKHEATON.—New Head Post Office; to be lit by electricity. Howorth and Howorth, architects, Cleckheaton.

COWES (I.W.).—New public schools. County architect, 5, St. Thomas's Street, Ryde, I.W.

DERBY.—Motor garage in Becket Street for Attrey & Co. Architects, Naylor & Sale; contractors, E. Wood & Sons, Derby.

Extensions to Women's Hospital, Bridge Street. Architects, Hunter & Woodhouse; builders, Messrs. Walkerden.

Reconstruction of premises at corner of St. James's Street for United Counties Bank. Builders, Messrs. Lowe, of Burton.

DUNDEE.—Alterations to shop for W. T. Bruce, Ann Street and North William Street.

Alterations to bakery for A. G. Kidd & Son, Ltd., Baffin Street.

Warehouses for D. McMaster & Co. in Guthrie Street.

FORFAR.—Proposed swimming baths and gymnasium (£5,000).

FOOTS CRAY (Kent).—New public schools (£3,822). C. E. Skinner, builder, Chatham.

HOLYHEAD.—New Calvinistic Methodist church and schools. R. L. Jones, architect, 14, Market Street, Carnarvon.

HYDE JUNCTION (Cheshire).—Extensive new carriage works for the railway company. Craven & Markham, builders.

INVERNESS.—Mortuary, &c. Ross & Macbeth, architects, Inverness.

KIRKCALDY.—Sanatorium to be erected by Town Council.

New church for St. John's parish, plans approved.

LANCASTER.—Secondary school for girls to be built by the T.C. (£16,114).

LEICESTER (Narborough).—Isolation Hospital at the Leicestershire and Rutland County Lunatic Asylum. Everard, Son & Pick, architects, 6, Millstone Lane, Leicester.

LEEDS (Calverley).—Detached residence, gardener's house, &c. H. W. Long, architect, Greengates, Bradford.

LIVERPOOL (Maghull).—New home for epileptics to be built (£8,000).

LONDON (Shoreditch).—Five-storey warehouse at corner of Scrutton Street and Clifton Street.

(Aldwych).—Offices for Victorian Government. Hon. J. W. Taverner, agent-general for Victoria, 142, Queen Victoria Street, E.C.

(Kilburn).—Theatre. W. G. R. Sprague, Criterion Chambers, Jermyn Street, W., architect.

(Peckham Rye).—Store buildings for Metropolitan Asylums Board. T. W. Aldwinckle & Son, 20, Denman Street, London Bridge, S.E.

(Greenwich).—Workshop for Merryweather & Sons, fire engine makers, Greenwich Road, S.E.

(Battersea).—Flats in Latchmere Road. W. G. Ingram, 4, Verulam Buildings, Gray's Inn, W.C., architect.

(W.).—Extensive buildings (shops, &c.) at corner of Tottenham Court Road and Warren Street. Phillips, Phillips & Co., 6, Newman Street, Oxford Street, W., agents.

(Oxford Street, W.).—Rebuilding shop. G. Trollope & Colls, Ltd., 77, Gresvenor Road, builders.

(Battersea Rise).—Three shops, garage and workshop. R. C. Radford, 189, Upper Richmond Road, Putney, architect.

(Hackney).—Buildings with shops. G. H. Lovegrove, 170, High Street, Shoreditch, architect.

(Hackney).—Vicarage. Rev. Thos. Ward Chambers, M.A., vicar Christ Church, Hackney, N.E.

(E.C.).—Rebuilding 153, Fleet Street. J. V. Kiddle & Sons, 24, Eldon Street, Norton Folgate, E., builders.

(Bethnal Green).—Warehouses for Allen & Hanbury, Ltd. (£8,000). P. K. Allen, Tunbridge Wells, architect.

(N.W.).—Shops, show-rooms, &c., on site of 297-299, Euston Road, and 72-3, Warren Street. Garrett, White & Poland, 16, Hanover Street, W., agents.

(Leyton).—Additions to wire works. A. W. Hudson, 87, Finsbury Pavement, E.C., architect.

(Homerton, N.E.).—Workhouse buildings. A. E. Pridmore, 2, Broad Street Buildings, E.C., architect.

MELBOURNE (Derbyshire).—New Roman Catholic Church. Mr. Evans, architect, Wheeler Gate, Nottingham.

MIDDLESEX.—Seven new schools and enlarging five existing schools (plans being prepared). H. G. Crothall, architect to the Education Committee, Guildhall, Westminster.

MORPETH.—Alterations and additions to Bothal Castle. Plans just passed by the R.D.C.

NEWARK (Balderton).—Wesleyan Chapel. W. M. Smith, Newark, builder Brewill & Baily, Nottingham, architects.

NORTHALLERTON.—Extensions to weaving sheds at Brompton. T. Winn and Sons, Albion Street, Leeds, architects.

NORTH SHIELDS.—New Roman Catholic schools. H. Gibson & P. J. Steinlet, architects, North Shields.

PARKSTONE (Dorset).—New Church (St. Luke the Evangelist), Sandecotes, lit by electricity (cost, £8,000). Goddard & Sons, builders, 66, East Street, Farnham, Surrey.

ROSS (Herefordshire).—Residence. Groome & Bettington, architects, Hereford.

ST. ALBANS.—Works at County Asylum, Hill's End. G. T. Hine, architect, Parliament Street, Westminster, S.W.

New church for St. Paul's Parish to be built (£20,000).

SHEFFIELD (Hathersage).—Wesleyan Church and schools. Smith & Ensor, architects, 1, Hartshead, Sheffield.

(Billsborough).—Centenary Hall and Sunday Schools (£1,600). H. Harper, architect, Nottingham.

ST. HELENS.—New schools in College Street. F. S. Biram, architect, Hardshawe Street, St. Helens.

SOUTHAMPTON.—Engineering works for Harland & Wolff, Belfast (£30,000). Waring-White Building Co., London, contractors.

TEDDINGTON.—Baptist Sunday school (£3,500). L. W. Simpson, Carlton Chambers, Regent Street, W., architect.

WHITEHAVEN.—Secondary school for the County Education Committee. Grayson & Ould, architects, 31, James Street, Liverpool.

WILMCOTE (Warwickshire).—Station buildings for G.W.R. G. K. Mills, secretary, Paddington Station, W.

WINCHESTER.—Nurses' Wing to Royal Hants County Hospital (£4,000).

CONTRACTS OPEN and CLOSED.

OPEN.

Adelaide (S.A.).—July 10th. The Postmaster-General requires tenders for 5 miles of insulated copper wire, two switchboards, two lightning arrester boards, 500 No. 2 Leclanché cells, 12 differential galvanometers, 15 electromagnetic transmitters, six plug pattern registering boxes, 500 copper tapes, 5,000 copper binders. Particulars may be obtained at the Commonwealth Offices, 72, Victoria Street, Westminster.

Belfast.—June 1st. Lighting switchboard and motor-generator for the Corporation electricity station. See "Official Notices" May 17th.

Belfast.—June 15th. Coal bunkers and electric travelling crane for the Corporation. See "Official Notices" to-day.

Dartford.—June 11th. Annual supplies (oils, meters, cut-outs, cable, stores, etc.) for the U.D.C. See "Official Notices" May 17th.

Dublin.—June 13th. Sub-station switchboards, transformers and accessories for the Corporation Lighting Committee. See "Official Notices" to-day.

Ealing.—June 1st. One water-tube boiler for the electricity works. See "Official Notices" May 10th.

Great Yarmouth.—June 4th. The Corporation requires tenders for tramway stores for 12 months. Particulars are obtainable from the General Manager, Caister Road.

Hackney.—Tenders are to be invited for (1) the wiring, etc., of the Central Library, and (2) the purchase of discarded Worthington pumps and scrap metal.

Heston and Isleworth.—June 3rd. Electricity meters for the U.D.C. See "Official Notices" May 24th.

Holland.—June 3rd. The municipal authorities of Amsterdam are inviting tenders until the 3rd prox. for the supply and erection of two sets of steam turbines and dynamos of 4,000 KW., required in connection with the extension of the electric lighting undertaking.

Ilford.—June 11th. Repair and maintenance of battery for the U.D.C. See "Official Notices" May 24th.

L.C.C.—June 11th. Electrically-operated car traversers. See "Official Notices" May 24th.

L.C.C.—June 11th. High and low-tension switchgear for five tramway sub-stations. See "Official Notices" April 26th.

L.C.C.—June 11th. High and low-tension cable. See "Official Notices" to-day.

Limerick.—June 11th. Stores for the Electricity Department. See "Official Notices" May 10th.

Nelson.—June 3rd. One Lancashire boiler with superheater and steam pipes. See "Official Notices" May 17th.

New South Wales.—June 12th. The Postmaster-General requires tenders for 91,500 insulators, 1,800 telephones, 80 combination telephones, 85 Secrephones, 150 coin attachments, 100 junction switches, 1,000 metallic plugs, 600 switching cords, 140 miles of copper wire, and 135 tons of galvanised iron wire. Particulars may be obtained at the Commonwealth Offices, 72, Victoria Street, S.W.

Partick.—June 3rd. Stores for the electrical department. See "Official Notices" May 24th.

Queensland.—June 24th. Supply of Post and Telegraph Stores. See Note in this column May 17th issue.

Spain.—Tenders have just been invited by the municipal authorities of Salvatierra de los Barros (province of Badajoz) for the concession for the electric lighting of the town.

Spain.—The "Campania Electrica Madrilena de Traccion" is seeking a concession for an electric tramway in Madrid between the "Calle de Alcalá" and the "Plaza de la Independencia." Other applications for this concession on terms more favourable to the Government must be presented by June 8th. A new company entitled "La Dinámica Espanola" has been formed at Barcelona with a view to utilising several waterfalls on the Tagus for the production of motive power, which would be transmitted to Madrid. The capital of the company is fixed at 5,000,000 pesetas. "La Industria Eléctrica de Barcelona" is increasing its capital, with a view to modernising the equipment of its generating works, and a company has been formed at Torres (province of Jaén) to establish electric lighting works in that town.—*Board of Trade Journal.*

Swansea.—June 4th. Arc lamps and pillars, resistances, choking coils, &c., for the electricity department. See "Official Notices" May 24th.

Warrington.—June 5th. Low-tension cable for the Corporation. See "Official Notices" May 24th.

Wimbledon.—June 17th. Flame arc lamps and lamp columns for the Corporation. See "Official Notices" to-day.

CLOSED.

Belgium.—La Société Electricité du Pays de Liège, of Schlessin-Ougrée, has submitted the lowest tender for the supply of electrical energy for public and private lighting and power purposes in the little town of Ougrée, near Liège, quoting 6 centimes and 12 centimes per KW.-hour, according to the time and purpose of the supply.

Birmingham.—The T.C. has accepted the tender of the Phœnix Dynamo Manufacturing Co., Ltd., for the supply of a balancer-booster set at £692; that of the Electric Power Storage Co., Ltd., for a battery and maintenance for ten years at £120 a year, and that of Mr. J. Johnson for extension of buildings at £1,208.

Enville Hall (Staffs.).—The District Electric Co., of Wolverhampton and Stourbridge, have received instructions to carry out an extensive installation for electric lighting, &c., at Enville Hall, Staffs.

Genoa.—It is reported from New York that the American Westinghouse Co. have obtained the contract for the construction of an electric tramway system for Genoa, at a cost of about $3,000,000.

Govan.—The contract for electric motors from ½ to 4 H.P. has been placed with Messrs. Electromotors, Ltd., Openshaw, Manchester.

Japan.—The Chloride Electrical Storage Co., Ltd., have in hand two batteries, each consisting of 286 cells capable of giving 1,200 amperes discharge, and two "Entz" type reversible boosters for the Hanshin Electric Railway.

Longton (Staffs.).—The Corporation has accepted the tender of the Chloride Electrical Storage Co., Ltd., for 250 cells, with a capacity of 420 ampere-hours.

Mexborough.—We understand that the Corporation has accepted the tender of the Chloride Electrical Storage Co., Ltd., for 250 cells, with a capacity of 600 ampere-hours, to replace the existing A.B.P. battery.

Southend-on-Sea.—The T.C. has accepted the tender of Messrs. E. Pratt & Co., of Halifax, for a hydraulic wheel-press for the tramway department, at £105.

Sydney (N.S.W.).—Messrs. Electromotors, Ltd., Openshaw, Manchester, have again obtained the contract for direct-current motors from ½ to 25 H.P.

Walthamstow.—The U.D.C. has accepted the following tenders in connection with the electric lighting and tramways undertakings:—

J. Spencer, Ltd.—Standard poles, £5 14s. each.
Dick, Kerr & Co., Ltd.—16 bases, 16s. 6d. each; 18 sets of scroll work, 15s. 6d. per set; 2 sets scroll work span carriers, 11s. 8d. per set.
J. Baker & Co.—120 car-wheels, £15 15s. per ton.
British Thomson-Houston Co.—Four circuit-breakers for the traction switchboard, £18 19s. 6d.
Westminster Engineering Co.—Re-winding armatures, £115.

FORTHCOMING EVENTS.

Monday, June 3rd.—At 7.30 p.m. Society of Engineers. Paper on "Working Experiences with Large Gas Engines," by Mr. C. A. St. George Moore, B.A., Camb.

At 2.30 p.m. Oxford Court, Cannon Street, E.C. Special meeting of members of London Chamber of Commerce, to hear an address by Mr. E. T. Crowe (Commercial Attaché to H.B.M. Embassy at Tokio) on "Trade with Japan."

Thursday, June 6th.—At 3 p.m. Royal Institution. Prof. Sir James Dewar on "Chemical Progress—Work of Berthelot, Mendeleeff and Moissan." (Lecture III.)

Friday, June 7th.—At 9 p.m. Royal Institution. Prof. Sir James Dewar on "Studies in High Vacua and Helium at Low Temperatures."

Thursday, Friday and Saturday, June 13th to 15th.—Meeting of the Institution of Mining Engineers at Burlington House, London. The visits include one to Park Royal generating station of the G.W. Railway.

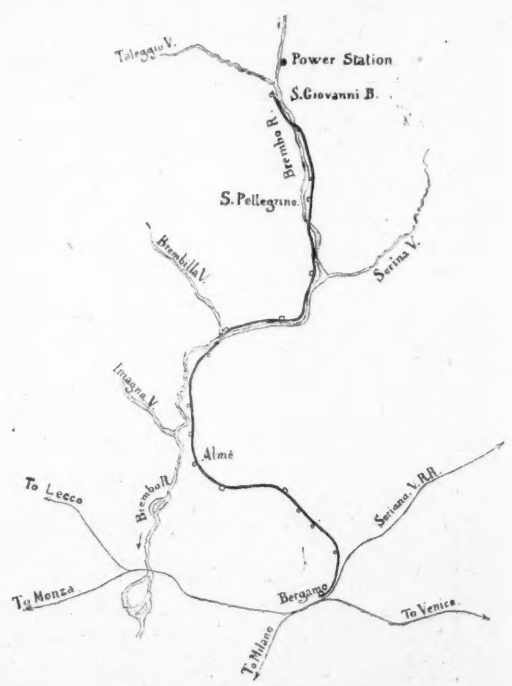


FIG. 1.—ROUTE PLAN OF THE BREMBANA VALLEY RAILWAY.
(See next page.)

The Electrical Manufacture of Steel.—M. G. Gin, of Paris, has taken out patents for an apparatus for the electrical manufacture of steel, which comprises three different furnaces for the oxidation of the ore, its reduction to the metallic state, and the carburising of the metal, respectively. The apparatus consists of a horizontally disposed structure of approximately square horizontal section. It is divided into three separate chambers on the same level, the first containing three vertical electrodes, the second and third containing two electrodes each. The three electrodes in the first receptacle are connected with one pole of the dynamo, while the electrodes in the second and third receptacles are connected in parallel with the other pole. The first chamber communicates with the second, and the second with the third, by means of circular channels which are constructed of such diameters that the resistance of the metal which fills them is sufficient to act as a source of heat, keeping all the metal in the baths in a state of fluidity. The apparatus is brought into action by adding fused pig-iron through a convenient opening into the first furnace, whence it flows into all three. In the first chamber the metal is covered with ordinary ironstone, or with a slag rich in ferric oxide, lime being added if the iron under treatment contains much phosphorus. In the second and third furnaces the baths are kept neutral. All the vertical electrodes are arranged in the usual fashion, so that they can be raised and lowered.

THE SINGLE-PHASE RAILROAD of the BREMBANA VALLEY (ITALY).

By E. A. KERBAKER.

The Brembana Valley, situated in the northern part of Italy, is formed by the southern ranges of the Alps (Maloja and Bernina), and including several neighbouring smaller valleys, all inhabited, the local population exceeds 40,000.

Generally speaking, the Brembana Valley is best known for the watering place named S. Pellegrino, frequented every summer by several thousand visitors; but, in addition, a good many industries are carried on, such as cotton and silk, cement, pottery and textile manufactures.

A year ago this Valley had no railway service at all, and the passenger and goods traffic was dealt with by coaches and carts; as soon, however, as the train service started, the traffic greatly increased, exceeding the expectations of the promoters of the scheme.

This new line starts from Bergamo, an old Italian town with about 45,000 inhabitants, some 50 km. from Milan; as shown in fig. 1, after a short distance it enters the valley of the Brembo, and ends at S. Giovanni Bianco, some 30 km. from Bergamo.

On account of the mountainous character of the country, some heavy work was involved, including 17 tunnels and three big bridges. The curves are all of a greater radius than 150 m.; the maximum gradient is of 2·4 per cent. on a length of nearly 1 km.; while Bergamo is 247 m. above sea level, S. Giovanni Bianco is some 400 m.

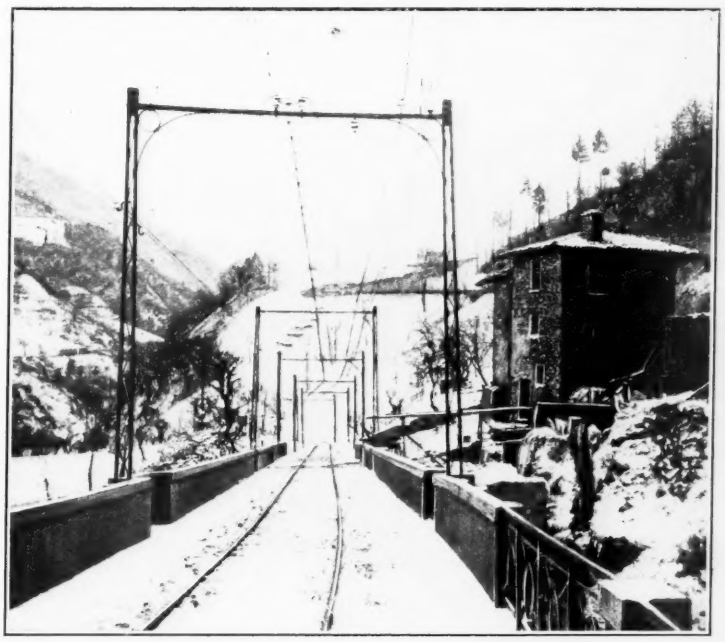


Fig. 2.—Single-phase Overhead Construction, Brembana Valley Railway.

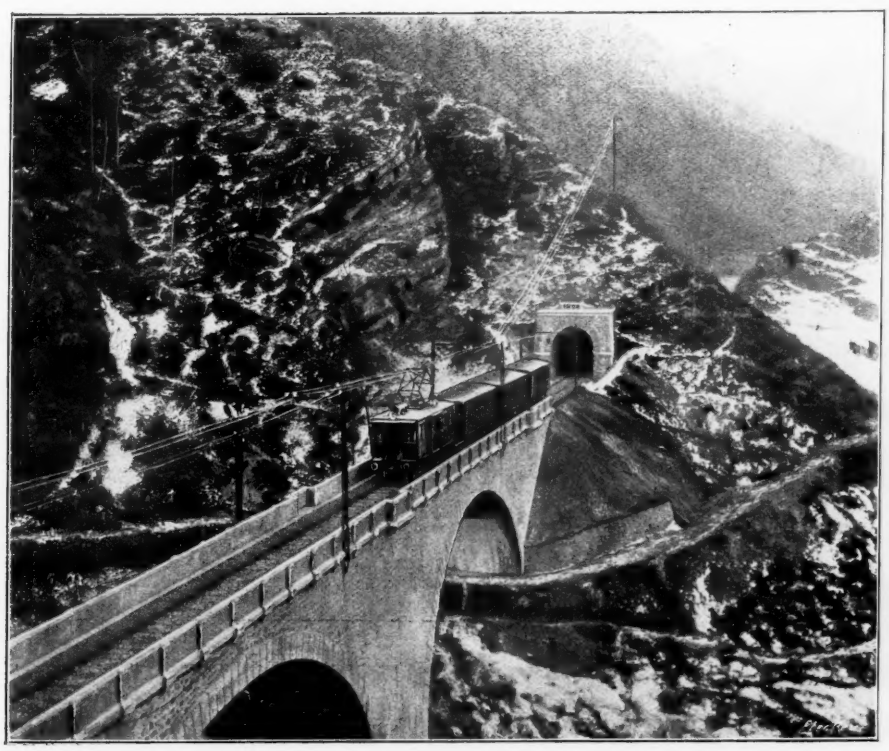


Fig. 3.—View on the Route, Brembana Valley Railway.

The railroad is single track and of normal gauge; the rails employed weigh 27·5 kilos. per m., and were furnished by an Italian factory. Only one side of the track is electrically bonded, the bonds being of the Chicago type.

In all seven stations, with turnouts and all the necessary appliances for traffic, are provided; there are also seven simple stops for passengers only.

A consideration of the number of passenger and freight

trains to be run, led the promoters to utilise a waterfall on the River Brembo, situated at about 1 km. from the northern end of the line, as a source of power; among the different traction systems proposed, the most suitable was

Fig. 4.—Arrangement of Trolley Wire in Tunnels.

considered to be the high-tension single-phase system, proposed by the Westinghouse Co.

Single-phase current is generated directly at 6,000 volts and 25 periods, and transmitted to the trolley line and to a feeder, this latter being connected at every station with

The catenary system was chosen for the trolley line, this system being considered sufficiently safe by the Italian Government for a pressure of 6,000 volts.

The supporting cable is of steel, with seven strands, each 2 mm. in diameter. On a 35 m. span, the sag of the above cable at 15° C. is about 39 cm., and its tension about 300 kilos.; while at zero its tension is about 425 kilos. The trolley wire is of copper, of 50 sq. mm. section; this wire is suspended from the supporting cable every 2·5 m. by means of a rigid iron hanger. Since the trolley wire has a fig. 8 form, the attaching of the hangers with mechanical clips of malleable cast-iron was easy.

The insulators which carry the supporting cable (fig. 8) were designed specially; they are double (as required by the Italian Government), being composed of a central

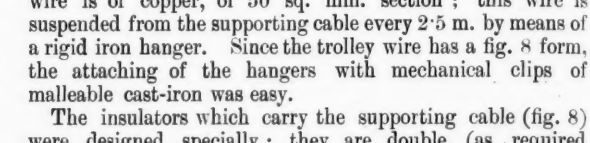


Fig. 5.—Electrical Connections at each Railway Station.

part surrounded by a second insulator, cemented on with a litharge composition. The umbrella on the upper part of the insulator has proved to be very effective in snow storms, which in winter time happen very often in the Brembana Valley. When dry, these insulators will carry up to 50,000 volts; when wet, 15,000 volts.

The two insulators are mounted on a cross bar, supported on two side poles; each cross bar is formed of two U irons, and has an average length of 5·5 m. Bracing is employed underneath to stiffen the system.

The poles are of pine, injected with a preservative composition (Giussani process). This consists in soaking them for about six hours in a bath of heavy mineral mineral oil at 140° C., and subsequently immersing them in a solution of chloride of zinc. So prepared, the poles are said to resist

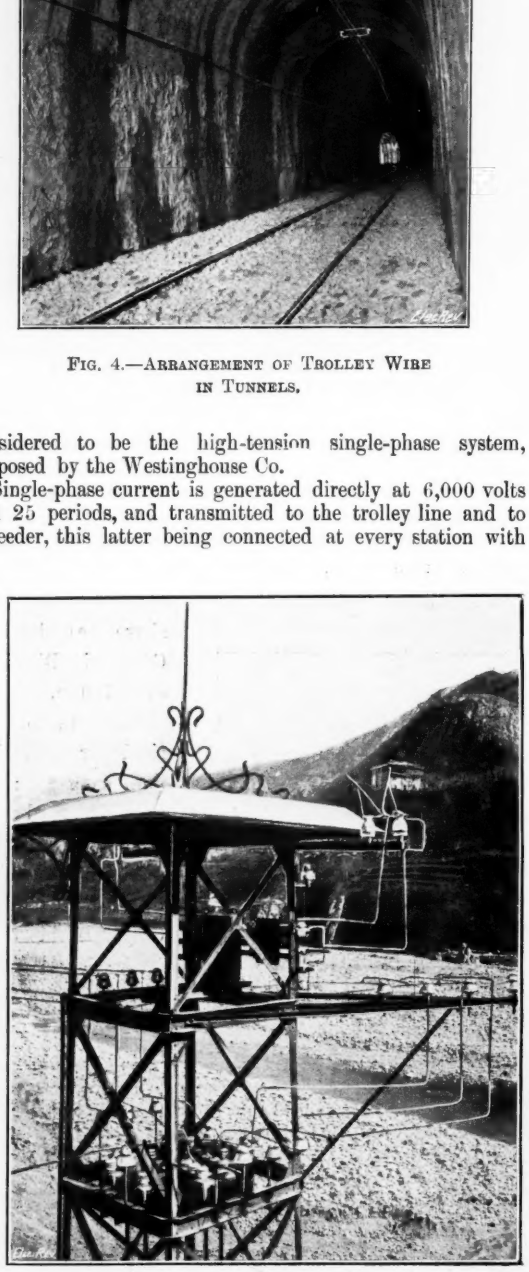


Fig. 6.—Top of Section Tower, showing Oil Switches, Arresters, &c.

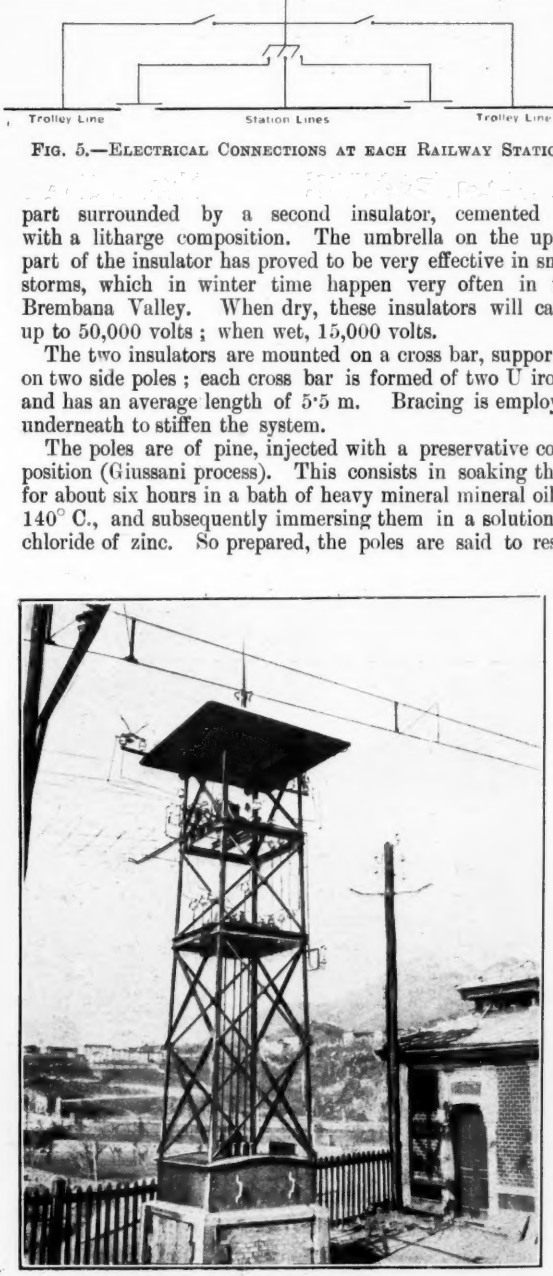


Fig. 7.—Section Switch-Tower at Railway Station.

the former. Besides these two conductors, there are two more, also at 6,000 volts, for the lighting service, which is quite separate from the traction service, and therefore not affected by considerable voltage drops.

deterioration much longer than usual, especially the part under and near the ground. They are, however, more inflammable; and in case of a "short" through a pole, this, if under rain, may fire quickly.

Where it was impossible to use two poles, a bracket system was employed.

In order to keep the catenary always in a vertical plane, at each suspension on straight line work, two special steady strains were used, which prevent the trolley wire from twisting round the supporting cable. This also saves the bow from being slotted or broken by the nuts of the hanger clips.

On curves the anchorings are made with ordinary cable and the same type of insulators.

The length of span on the straight is 35 m., while on curves this length decreases according to the radius and to the staggering allowed to the line.

On the bridges, iron arcades are used (figs. 2 and 3); and in many stations, on account of the small room between the tracks, lattice girders are employed (fig. 9).

In tunnels (fig. 4) the trolley wire is suspended from the roof; the height of the tunnels is 5 m., while the distance of the trolley wire from rails is 4·5 m. In outside work, this distance is 6 m., as required by the Italian Government.

The feeder and lighting wires, which are run throughout the line, are mounted on special insulators on one of the side poles, while on the opposite pole are mounted the telegraph insulators. The telegraph cable passes through the tunnels but the high-tension transmission lines go outside.

The telegraph wires are transposed every two spans. It was found that the effect of induction was much decreased by using good telegraph insulators, giving a higher degree of insulation than usual; it was also found that condensers, when duly chosen and distributed (between the two wires and the ground), may neutralise nearly all the induction effects, even with a poor insulation; this method, however, cannot be recommended, because ordinary condensers are easily perforated during storms.

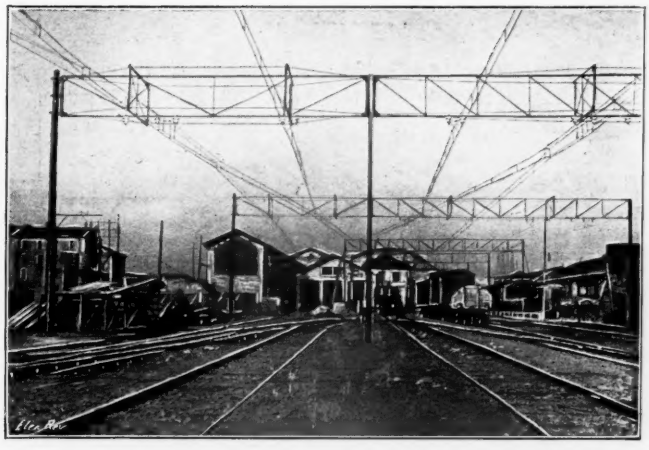


Fig. 9.—Overhead Construction at Railway Stations.

Every railway station has a section insulator at both ends, and can be isolated from the rest of the line. Four pairs of poles, 12 metres apart, anchor the lines outside stations. Fig. 5 shows the scheme of electrical distribution, from which it may be seen that either the catenary or the feeder can be cut out of service on every part of the line, for repair. The switches used are all of the oil type, fixed on an iron tower (fig. 7); on the same tower is mounted the transformer (generally 2 K.V.A. 6,000/100 volts, 25 periods) with high-tension fuses, lightning arresters and switches for the lighting service of the adjacent station. Since energy for lighting is supplied by a special alternator at 6,000 volts and 25 periods, to provide against accident to this alternator or the lighting line, two commutators allow of the transformer being put in the traction circuit.

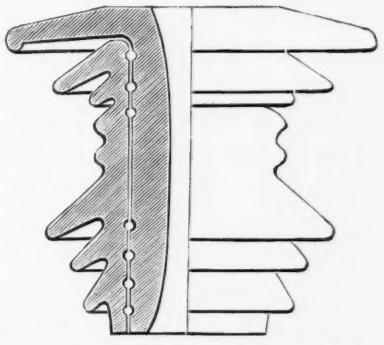


Fig. 8.—Type of Insulator used for Carrying Supporting Cable and Trolley Wire.

The oil switches shown in fig. 6 are mounted in the top of the tower, and operated mechanically from below, by a special lever kept only by the stationmaster.

Besides the lightning arresters for lighting service, there are also other lightning arresters for the trolley wire and feeder, altogether 1 per km. on the average; these arresters are of the horn type, with resistance on the ground side.

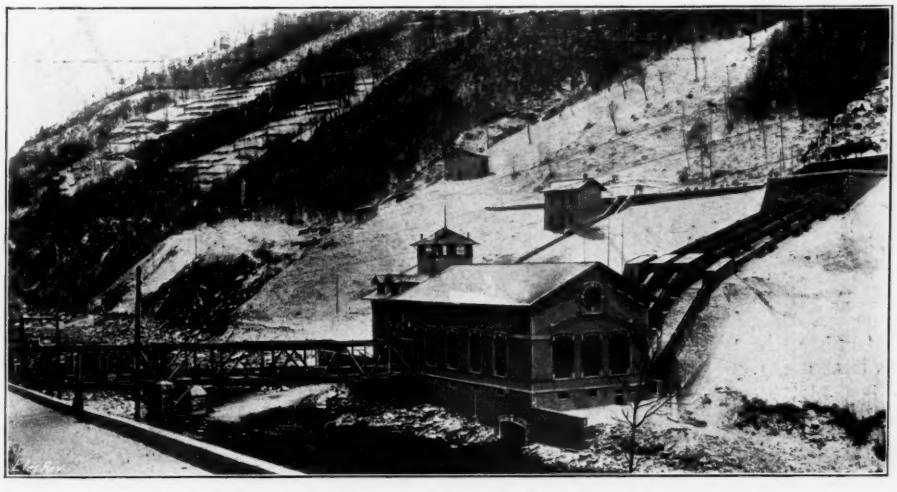


Fig. 10.—View of the Hydro-Electric Power Station, Brembana Valley Railway.

The power station, which is located about 1 km. from the northern end of the line, operates under a head of water of 27 m.

There are three generating units, each composed of one turbine Riva-Monneret (Milan) coupled to a Westinghouse alternator, single-phase type, of 500 K.V.A., at 6,000 volts and 25 periods, with a speed of 500 R.P.M. Two of these alternators are supposed to run in parallel while the third is kept in reserve. The turbines are fitted with the Riva-

FIG. 11.—SINGLE-PHASE LOCOMOTIVE, WESTINGHOUSE SYSTEM.

With this arrangement all the big switch panels are abolished, each machine having a small iron column on which are mounted the voltmeter, main and field ammeters, and the various small distant control switches.

All the wiring is of bare copper wire or strip, arranged in a special basement under the alternators. The outgoing circuits are led up a tower, where the choke coils and lightning arresters, of the Wurtz type, are fitted.

The Valle Brembrana Railroad Co. now has in service five single-phase locomotives, each weighing about 36 tons.

They were constructed by the Breda works, in Milan, while the electrical installation was supplied and fitted by the Westinghouse Co. The locomotives (fig. 11) are divided into two driver's cabins, a compartment for baggage, and another for the mail service, one for the air compressors, and one for the multiple-control apparatus. In the compressor compartment are

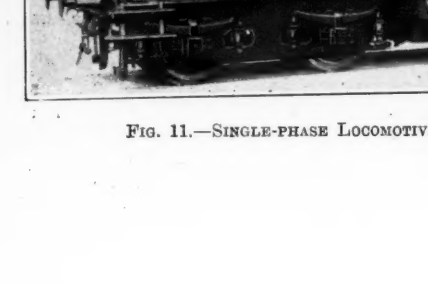


FIG. 12.—CHARACTERISTIC CURVES, WESTINGHOUSE SINGLE-PHASE TRACTION MOTORS.

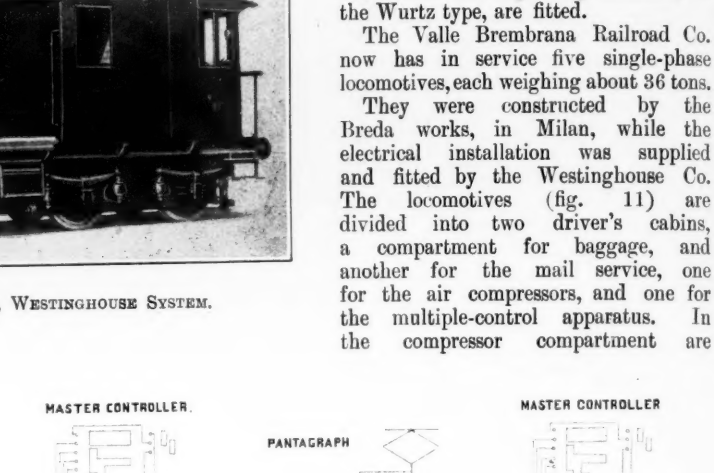


FIG. 13.—DIAGRAM OF ELECTRICAL CONNECTIONS, WESTINGHOUSE SINGLE-PHASE LOCOMOTIVE EQUIPMENT.

Monneret oil governor; and a Tirrill regulator is inserted in the alternator circuits to keep the voltage within close limits, by short-circuiting the field rheostat of the exciter.

Two exciters, each of 30 KW. at 125 volts, are directly driven by two turbines; one of these exciters only is required for normal service.

For the lighting service there is a special set consisting of a turbine coupled to a single-phase alternator of 50 K.V.A., 6,000 volts and 25 periods at 750 R.P.M. This frequency enables the transformers all long the line to be put on the traction circuit, if necessary.

The switchboard is of modern type, made by the Magrini Co., of Bergamo, which firm, with the Fantini Co., of Bergamo, are the only important Italian makers of switchboards and electric apparatus. The characteristic of the switchboard in question is the distant operation of the high tension and low tension switches, the necessary energy for this being taken from the exciter.

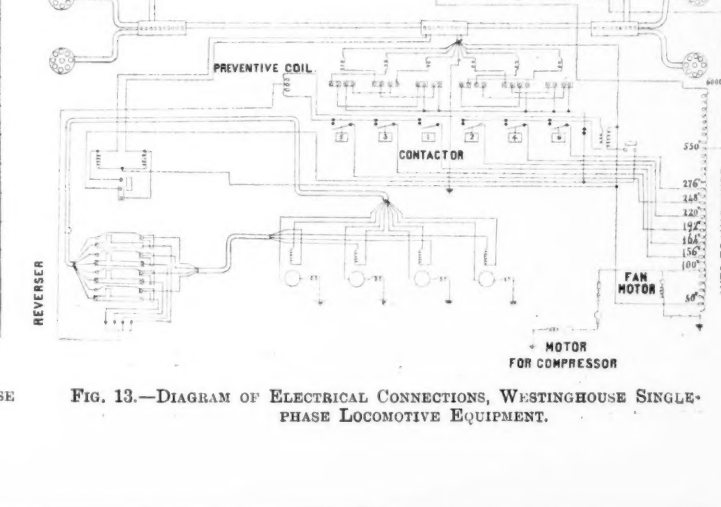


FIG. 14.—MOTOR TRUCK, SINGLE-PHASE LOCOMOTIVE.

installed two air tanks (for the multiple control and whistle), while the main air tank is situated on the roof of the locomotive, as well as the Wurtz lightning arresters. In the middle of the roof is mounted the pantograph bow: the contact shoe is of soft copper, 1·2 m. long, with two longitudinal slots for the grease. The pressure of this bow on the overhead wire is regulated to about 7 kilos., and there is no appreciable difference in the pressure with the trolley wires at 6 or 4·5 m. high. Tests made with a pressure of 6 kilos. showed that sparking could not be avoided with speeds exceeding 40 to 45 km. per hour, while, with a pressure of 7 kilos., sparking was practically absent. Even with a pressure of 8 kilos., the catenary always keeps vertical and the sparking conditions are very good at speeds of 60 km. per hour; but if any slackness occurs in the lines an inclination of the catenary plane results, and this causes slots in the bow shoe.

The H.T. current from the bow passes to a transformer situated underneath the locomotive, between the two trucks. This connection consists of a high tension cable enclosed in a brass tube, which is grounded and situated in a wooden slot.

The transformer is air-cooled by a small motor-driven fan, which runs continuously. There are several terminals on the L.T. side for pressures varying from 50 to 500 volts. All the multiple-control apparatus is energised at 50 volts; the air compressor motor (10 H.P.), the fan motor and the locomotive lighting runs at 100 volts; pressures up to 250 volts are required for the motors, and 500-volt current is employed for lighting and heating the passenger cars.

The Westinghouse electro-pneumatic system of multiple control is employed; each locomotive has four 75-H.P. single-phase motors, with simple gearing (15/70) and wheels 1 m. diameter.

As is known, the arrangement of the Westinghouse single-phase motor resembles the D.C. motor, being also in series with the collector; but some important variations were made in order to secure perfect running. In addition to the ordinary series winding in the field circuit, there has been added in series a second or compensating winding, with a view to increasing the power factor. Moreover, when an armature coil is short-circuited by a brush considerable sparking results, and in order to avoid this, the resistance of the coil circuit has been increased by connecting the terminals of the coils to the collector with a metallic resistance arranged in the slots in the same way as the coils. Under these conditions the motors give very good results.

In addition to the Westinghouse air-brake, a hand-brake is provided, which can be operated from each end of the locomotive; with a pull of 20 kilos. on the operating wheel, a brake effort of 15,000 kilos. can be obtained, or, say, 45 per cent. of the locomotive weight.

The schedule speed realised with these locomotives, with light passenger trains and on light up gradients (average 1 in 200) has been some 55 km. per hour, on a length of 2,700 metres. Freight trains of 70 tons are hauled on an up gradient of 2·4 per cent. at a schedule speed of 24 km. per hour.

Tests have also shown that it is possible to reach an acceleration of 50 cm. per second per second; and while the power factor at starting is not high, in normal running it is above 0·80.

NOTES.

Reunion of E.E.R.E. (Vols.).—Members who served in the war are reminded that a proposal is on foot to bring about a reunion of active service members. Particulars may be obtained from the provisional committee, Messrs. Coxon, Dallison and Mason, c/o the ELECTRICAL REVIEW.

Merchant Venturers' Technical College, Bristol.—The *Times* states that the plans for the restoration of the main building of this college, which it will be remembered was destroyed by fire recently, have now been approved; they involve very considerable changes in the arrangements of the building. In the basement there will still be the engineering workshop and forge, also the electrical engineering laboratory and the hydraulic laboratory, but both will be much larger. A portion of the space at the back of the college will be covered over, and in it will be placed the experimental engine, dynamos, and central electric light and power station, now situated in the Rosemary Street branch building of the college, as well as the testing machines of various kinds. On this floor also will be situated the rooms of the professors of electrical engineering and motor-car engineering, the boiler-house, heating chamber, and battery house. The governors are concentrating the work of their college so as to provide a much more extensive equipment for those departments which train civil, mechanical, electrical, mining, and motor-car engineers, and which prepare for the B.Sc. degrees of the University of London in science and engineering. With this end in view they will discontinue certain portions of the work formerly undertaken by the college.

Improved Leclanché Cell.—A German patent has been taken out by the firm of Siemens & Halske, of Berlin, for a new form of wet Leclanché primary cell. The essential feature of the invention consists in leaving a gas space round the central carbon electrode at the top of the element, closing this in with a horizontal gas-tight partition made of papier-maché saturated with paraffin wax, and casting a seal of some fusible material which is not attacked by alkali over the top. In this manner the ammonia evolved from the ammonium chloride electrolyte is prevented from escaping, and, indeed, if a sufficient amount is liberated the pressure may rise within the confined space in the upper part of the cell until the gas dissolves in the liquid. Moreover, it is said, the ammonia liberated reacts with the zinc chloride that has been formed, and converts some of the insoluble zinc hydroxide into a soluble basic zinc chloride, thus renewing some of the spent electrolyte.

Electric Welding and the Eyes.—The Departmental Committee on Compensation for Industrial Diseases, which has been sitting since July last, has just issued its report. Among injuries inquired into were cases of injury to the eyes from electric welding. The Committee reported that "Cases of such injury have occurred, due to the intensity of the light produced in the process. We have had no evidence, however, that incapacity, when it occurs, lasts for longer than a few days; and it appears that the injury can be easily avoided, and is, in fact, now avoided by the use of protective glasses by the workmen. In these circumstances there is, we consider, no valid reason for adding it to the schedule."

"Thou Shalt Not."—In the *Commercial World* (Boston, U.S.A.) there are given ten business world commandments, which we reprint from an American engineering exchange. The said exchange recommends steam engineers to apply these principles in their business affairs, and we would suggest in these very pushing and competitive times, that they might be studied, and perhaps applied, by British electrical engineers and salesmen in their arrangements both at home and abroad. In No. 8 there is a distinct Yankee advice to go trumpeting; we don't advocate going the full length of our trans-Atlantic cousins in this, but there is room for a little more of it than we conservative Britishers are generally noted for. No. 9 has in its latter half a flavouring of American slimness—the wisdom of the serpent with not all the harmlessness of the dove.

1. Thou shalt not wait for something to turn up, but thou shalt pull off thy coat and go to work, that thou mayest prosper in thine affairs and make the word "failure" spell "success."
2. Thou shalt not be content to go about thy business looking like a bum, for thou shouldst know that thy personal appearance is better than a letter of recommendation.
3. Thou shalt not try to make excuses, nor shalt thou say to those who chide thee, "I didn't think."
4. Thou shalt not wait to be told what thou shalt do, nor in what manner thou shalt do it, for thus may thy days be long in the job which fortune hath given thee.
5. Thou shalt not fail to maintain thine own integrity, nor shalt thou be guilty of anything that will lessen thy good respect for thyself.
6. Thou shalt not covet the other fellow's job, nor his salary, nor the position that he hath gained by his own hard labour.
7. Thou shalt not fail to live within thine income, nor shalt thou contract any debts when thou canst not see thy way clear to pay them.
8. Thou shalt not be afraid to blow thine own horn, for he who faileth to blow his own horn at the proper occasion findeth nobody standing ready to blow it for him.
9. Thou shalt not hesitate to say "No" when thou meanest "No," nor shalt thou fail to remember that there are times when it is unsafe to bind thyself by a hasty judgment.
10. Thou shalt give every man a square deal. This is the last and great commandment, and there is no other like unto it. Upon this commandment hang all the law and the profits of the business world.

Engineering Golfing Society.—We are informed that a number of engineers, who have been playing golf together, have formed themselves into a committee for promoting the establishment of an Engineering Golfing Society on the model of the similar societies already formed by the Bar, the Press, the London Solicitors, &c. It is proposed that membership be limited to Members, Associate Members, Associates, Graduates and Students of the Institutions of Civil, Mechanical and Electrical Engineers. The President of the Institution of Civil Engineers, Sir Alexander Kennedy, has promised to be the first President of the Society. Gentlemen desirous of becoming members are requested to communicate with Mr. Seymour Price Williams, of 5, Victoria Street, S.W., who has been asked to act as secretary, and who will send them the necessary particulars.

Water-Power in German Colonies.—The question of railway extensions in German Colonies in Africa, which has been brought forward in a memorial recently issued by the Colonial Department to the Reichstag, has led to the suggestion in semi-official quarters that consideration should be given to the problem of utilising the waterfalls available in the Colonies. It is pointed out that it would be easy to work by electricity the proposed railway in the Cameroons, from Duala, the principal place, to Jaunde, which is the centre of business in the south district. The railway would pass over the Sanaga River, which has a large fall of water near Edea at a distance of 43 miles from the coast, and which would be able to yield a considerable amount of power even in the dry season. It is considered that a power station would be in a position to deliver energy for the working of the projected railway, the electric lighting of Duala, and the coast places in the south and for the supply of power to the Government workshops and harbour works at Duala. The Neven du Mont falls of the Njong River, which are situated further to the south, could also be used for railway working and other purposes. In German East Africa, the Pangani falls, which are 117 miles distant from the coast in the lower Rufidji valley, could be brought into use, if not for the operation of a railway, at all events for driving the machinery employed in the briskly rising trade in cotton and for other purposes. It is considered that the water-power in other districts south of the Congo could also be profitably employed, and it is suggested that German engineers, in connection with the Colonial Economic Committee, should co-operate in the elaboration of schemes which would assist in the opening up of the Colonies, and, at the same time, prove to be remunerative undertakings and of advantage to the export trade of the Fatherland.

The M.E.A. Meeting at Sheffield.—The full programme of arrangements for this Convention has now been issued by the secretary:—

TUESDAY, June 25th. — At 10.30 a.m. Welcome at Town Hall by the Lord Mayor. Presidential address by Mr. S. E. Fedden. Paper by Mr. R. L. Acland, of Chesterfield, on "Extension of Electricity Supply to Outlying Districts."
12.45 p.m. Luncheon at Royal Victoria Hotel.
2 p.m. Visit to Messrs. Vickers, Maxim's River Don Works.
8 p.m. Reception and dance at Town Hall.

WEDNESDAY, June 26th.—9 a.m. Excursion to the Dukeries.

THURSDAY, June 27th.—10 a.m. At Royal Victoria Hotel Annual General Meeting.
2.30 p.m. Papers on: "Cheap Power Supply by Municipalities," by Mr. C. E. C. Shawfield, of Wolverhampton; "The Costs of, or Charges for, Electricity Supply," by Mr. H. R. Burnett, of Barrow-in-Furness; "Depreciation," by Mr. C. H. Yeaman, of Hanley.
7.30 p.m. Annual Dinner at Royal Victoria Hotel.

FRIDAY, June 28th. — At 10 a.m. Royal Victoria Hotel. "Alternating Current Distribution," by Mr. A. J. Cridge, chief assistant electrical engineer at Sheffield; also a paper on another subject (announcement later).
2.15 p.m. Visit to Kelham Island Tramway power station and Neepsend power house. Sheaf Street station will also be open for inspection.

The Rhine to Furnish 1,200,000 Horse-Power.—An astonishing calculation has been made by Major von Donat, of Munich, in regard to the utilisation of the water power of the Rhine in connection with Lake Constance as a storage reservoir. At the present time the Rheinfelden Works use 14,500 H.P., the Laufenburg concession contemplates 30,000 H.P., and the Rheinau project 7,360 H.P., and these and other schemes represent a total of 130,000 H.P. In the opinion of Major von Donat, however, it would be possible to obtain 1,200,000 H.P. permanently between Lake Constance and Breisach by the expenditure of a sum of approximately £10,000,000 on the execution of the works, and he estimates that the production of electrical energy would be effected at a very low price, which would seriously compete with steam power over a large tract of country. The scheme proposes the transmission of energy over considerable distances as, for instance, from Basle to Strassburg, Carlsruhe, Mannheim, Frankfort and Cologne; to the large Dutch towns 310 miles distant, and to Bremen and Hamburg, which are 434 and 496 miles away respectively. Having regard to the 403 miles transmission in connection with the De Sabla works in California, and to the scheme for the utilisation of the Zambesi Falls for the supply of power to the Witwatersrand mines, the Major contends that the technical possibility exists of delivering power from the part of the Rhine in question to the towns on the North Sea. But it would, perhaps, scarcely be necessary to extend as far as that in the transmission of power, as the Major is of opinion that the district of the middle Rhine would be able to utilise the whole of the power, and that the electrical energy would be able to beat steam power, even in the coal districts of the Saar and the Ruhr.

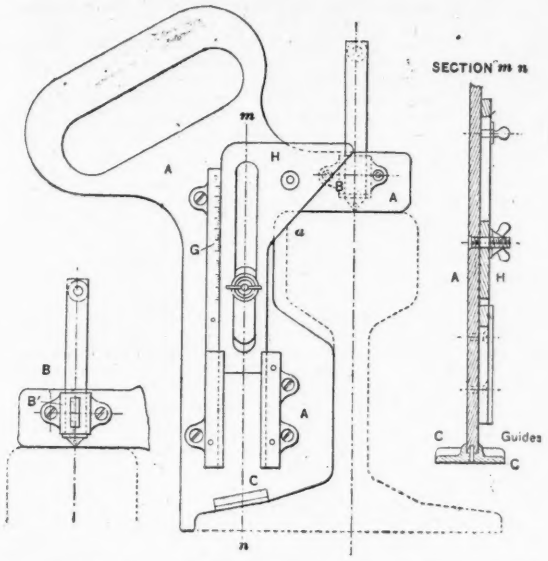
Cairo Electric Tramways.—The report of the Cairo Electric Railways and Heliopolis Oases Co., which was formed a year or two ago to develop the lands known as the Oasis of the desert of Abbassich and to construct an electric railway and two tramways between that place and Cairo, states that a new city is now rising on the spot. A provisional generating station has been built at Demerdache and is ready for work. The permanent station is being constructed at Choubrah, at that part of the Nile where the Charkavich canal ends. The equipment of the station will include three sets of turbo-alternators of high-pressure capable of furnishing a total of 10,000 H.P. A sub-station has been established near the Oasis d'Héliopolis, which is the name give to the new town. This plant will deliver the energy required for the public and private lighting of the place, and for the working of the railway and tramways. The construction of the lines intended to connect the Oasis with the centre of Cairo has been commenced, and as a result of an agreement with the Société des Tramways de Caire it will be possible to start a service between Cairo and Abbassieh to the Oasis next October. Among the directors of the company appear the names of Lord Armstrong, Sir Augustus Fitzgeorge, Sir Jules Jacobs and Sir John Rogers Pacha, Sir Reginald L. Oakes being the director-general.

The Magnet Musical Society (G.E.C.).—This society, which was formed some eighteen months ago by a few members of the General Electric Co.'s staff, made its first public appearance on Friday last, when it gave its first grand bohemian concert at the Cannon Street Hotel. There were 230 present, many of them being members of the G.E.C. staff, though, it should be mentioned, that the society also admits to membership, outsiders connected with the electrical trade. The chair was taken by Mr. H. Hirst, who, in a short speech, wished the society every success. Mr. D. Blattner, the president, who responded, gave a brief outline of the society, its objects, and so on. So far there are 60 members in the society. Those of our readers desirous of obtaining further information concerning the society should place themselves in communication with Mr. E. Joyce, the honorary secretary, at 71, Queen Victoria Street, E.C. Messrs. H. Hirst, Max Byng, and H. Bevis are patrons of the society. The programme contained some well-known artists. Mr. Will Van Allen (The Tramp), Miss Annie Purcell, and Miss Gladys Huxley (who were specially engaged by kind permission of the Tivoli management) were, in themselves, a host of talent. Miss May Currie, contralto, rendered her song, "Lovely Spring," with much taste and finish. Miss Leonora Russell also sang in her usual fine style. The Liedér Quartette came in as an "extra" with their quaint and musical medley. Mr. Frederick Stock, violinist, gave an artistic rendering of his items. Miss Margaret Cochrane, in her monologue, "Passing Cloud," showed to great advantage her elocutionary powers. Mr. S. H. Cross sang "The Bandolero" effectively. Mr. Humphry Bishop, Mr. George Luker, Miss Queenie Osborne, Mr. Frank Powell, Mr. Sen Holloway, Mr. Will Collings, and Mr. Lyell Johnston, all aided to bring the concert to a successful issue. Mr. E. A. Macfarlane presided at the piano. The evening was in every way a success, and proved an admirable send-off for the new society which, by the way, we understand, is to hold its second concert about October next.

A Lift Claim.—In the Shoreditch County Court on Tuesday, before his Honor Judge Smyly, K.C., the London Hoist and Machinery Co., of 103, Worship Street, E.C., sued Messrs. E. Lawrence & Sons, of 14, Wharf Road, N., for £21 7s. 6d., the price of a lift and its fixing. The defendants counterclaimed for £4 for injury done to electrical goods through the imperfect make of the goods supplied, and paid into court the difference. The claim was admitted, therefore the onus of proof rested on the defendants. Mr. Cairns, for them, said that the plaintiffs first supplied a crane to some tenants of Messrs. Lawrence on their behalf, the Autoclaw Co., a firm of electrical accessories suppliers; the crane was paid for, and subsequently the lift, which was sued for, was supplied. The usual warranty was given with the lift and the crane. The accident occurred with the crane, which damaged a cart, into which goods were being loaded, besides smashing a crate of electrical fittings, valued £3 0s. 6d. A boy, who was in the lift at the time of the accident, was badly injured, and was laid up for three weeks. The crate had been loaded into the lift and was to be lowered into the cart, when the hook connecting the chain with the lift snapped, and it fell, carrying the boy with it. The claim made by the Autoclaw Co. against Messrs. Lawrence for £10 damages, was subsequently settled for £4 to save bother.—An expert was called on behalf of Messrs. Lawrence, who said that the man who passed the hook must have been either wicked or blind when he knew that a life might depend on its being perfect. The hook had been made of two pieces which had not been properly welded together. Not sufficient heat had been used, so that it had worked hollow. He denied that inferior iron could account for it, as he said it would be impossible for it to work hollow if properly and sufficiently worked, in fact, it was well-known that the iron improved in condition the more it was worked. For the defence, it was submitted that the iron of the hook had never been welded at all, as it was one piece, it only having been heated to make the curve of the hook. The chain and the hook had been tested to a breaking strain of 1 ton, whilst the guaranteed carrying capacity was only half a ton. In these circumstances it was submitted that they had exercised all reasonable care, and could not be liable. Judge Smyly said that the defendants, in the counterclaim, were bound to their guarantee under the Sale of Goods Act. They said it was good iron, and if it turned out different they would have to stand by it. There would be judgment for Messrs. Lawrence on the counterclaim, with costs.

Bankruptcy Note.—In the Court of Bankruptcy, before Mr. G. Chapman on Wednesday, a meeting was held of the creditors of John D. Gibbs, whose statement of affairs showed liabilities £13,990 and assets consisting of two commission notes of uncertain value. The debtor stated that he had been connected with electrical undertakings for many years, more particularly in respect of a transforming system, which he patented in connection with a Mr. Gaulard. The meeting was adjourned for four months, with a view to the maturing of negotiations for the realisation of the debtor's concessions.

Gauge for Measuring Rail Wear.—According to the *Street Railway Journal* for April, Messrs. Calvi and Perrot, track engineers of the Metropolitan Underground Railway, of Paris, have recently designed a micrometer gauge for measuring the wear of rail heads and gauge line. Its construction is shown in the accompanying design, reproduced from *Le Génie Civil*. The piece A, which fits the contour of the base of the rail as well as the side of the web and top of the head, is provided with a handle.



Portable Gauge for Measuring Rail Wear, Used on the Paris Metropolitan Railway.

The vertical wear is measured by the graduated screw B, which is threaded in the socket B'. The wear at the gauge line of the rail is read by means of the sliding plate H and the scale G. This reading, of course, gives the resultant of the vertical and horizontal wear at this point, but as the incline at the corner of the rail is always at an angle of 45°, all readings can be corrected by the same constant. Both scales are provided with veniers. The gauge has been found very useful on the Paris Metropolitan Railway, where curves of 150 ft. radius are common, and where the radius in some cases is as low as 93 ft.

Calcium Cyanamide in France.—The French authorities have decided to impose an import tax on calcium cyanamide, on the basis of its being an artificial fertiliser.

Shock Accidents.—According to the *Blackpool Gazette* an electrician named Graves, aged 18, engaged in laying cables in a transformer chamber on the Pleasure Beach at Blackpool, received a shock at 200 volts while turning on a switch. He was thrown out of the chamber on to the sands unconscious, but he was restored by artificial respiration.

The *Daily News* of Wednesday last, states that at the Mountain Colliery, Gorseinon, near Swansea, a collier named Stephen Harries, aged 47, has been killed electrically. The electric current escaped along the hauling rope, and a fireman named Davies came in contact with the rope and shouted for help. Harries went to his assistance, but himself received a full shock, and was instantly killed.

Institution and Lecture Notes.—Royal Institution.—On Friday last Prof. J. A. Fleming, F.R.S., lectured on "Recent Contributions to Electric Wave Telegraphy." He stated that with Mr. Marconi's new method of creating continuous waves, any existing station for spark telegraphy could easily be converted into a station sending out undamped waves.

United Wards Club.—Mr. Bullocke, of the Marconi Co., gave a lecture last week at the Cannon Street Hotel before the members of this club, taking for his subject "Wireless Telegraphy."

East London College.—Mr. J. T. Morris, M.I.E.E., is on Monday evening next to commence a course of six lectures, illustrated with experiments and demonstrations, on "Electric Wave Telegraphy." The syllabus shows that the course will cover (*a*) The production of electric waves; (*b*) their detection; and (*c*) the measurement of quantities connected therewith.

Institution of Electrical Engineers.—On Friday last the annual general meeting of the Institution was held in its rooms at 92, Victoria Street, S.W., to receive the report of the Council, and the statement of accounts and balance-sheet for 1906. The election of the new Council was announced; the list of names has already appeared in our pages. The accounts show a total income of £10,641 9s. 10d., and an expenditure of £7,092 14s. 10d., leaving a surplus balance of £3,548 15s. to be carried to the general fund. The balance-sheet shows total assets £41,659 5s. 1d., of which £19,260 17s. 1d. is invested in buildings and building site. The general fund amounts to £10,221 17s. 2d., and is mainly invested.

Troubles of the Car Driver.—Sheriff Campbell Smith, of Dundee, one of Scotland's veteran judges, has been laying down the law to the car drivers. As a sequel to a smash on the new Dundee-Monifieth line, four ladies and their coachman sued the tramways company. His Lordship decided against the company, and gave the pursuers substantial damages. He held that a car driver was bound to go slowly at all points where there was danger owing to the narrow roadways and the vagaries of children in slummy localities, also of deaf and drunk men, and even of uneducated dogs and cats; and that when the defenders' ex-ploughman (the driver of the car) saw the pursuers' carriage and pair approaching the entrance gate to a mansion that he knew was so narrow that it required to be gone into not obliquely but directly, he ought not to have been so anxious to save a second or two of his invaluable tramcar time.

Self-Registering Electric Target.—Mr. J. A. Dickie has presented the Fleet Rifle Club with one of his patent self-registering electric sectional targets, complete with indicator, for the use of members.

Appointments Vacant.—Switchboard attendant for Durban Corporation (£240); charge engineer (£100) and canvasser (£80 + 2½ per cent. on new consumption) for Acton U.D.C.

Electric Supply Football League.—A meeting was held in the offices of the St. James and Pall Mall Supply Co., Carnaby Street, on Thursday, May 23rd. Representatives from the various electric supply companies attended, and the following appointments were made: Hon. Treasurer, Mr. Horobin, St. Pancras; Hon. Secretary, J. W. Fraser, L.C.C. Tramways Power Station, Greenwich; Hon. Registration Secretary, J. De Voil, St. James and Pall Mall. Applications are invited from electric supply companies' football clubs situated within 15 miles from Charing Cross, and should be addressed to the secretary.

Legal.—In the list of appeals down for consideration in the House of Lords on Wednesday was the case of the Electrical Power Storage Co., Ltd., *v.* Patent Exploitation, Ltd.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—Out of 135 applicants, Mr. G. E. Swift, of Plymouth, has been appointed mains superintendent at Chester at a salary of £150 per annum, with annual increments of £10 to £200.

Mr. E. J. Reindorp, charge engineer at the East Ham Electricity Works, who has obtained an appointment with the Cape Copper Co., Cape Colony, has been presented by the generating station staff with a cabin trunk and a knife.

Mr. H. H. Haywood has been appointed lighting inspector at a salary of £150 a year to Islington Borough Council, and Mr. D. J. Evans has been appointed assistant lighting inspector at a salary of £130.

The Southport Electricity Committee has appointed Mr. A. S. Black (assistant electrical engineer) acting manager in succession to Mr. R. S. Downe. Mr. Black's salary will be £300 per annum.

On the occasion of his departure to be married, the staffs of the Newcastle-upon-Tyne Electric Supply Co. and the County of Durham Electric Power Co. presented Mr. J. A. Seager with a case of cutlery to commemorate the event. The presentation took place in the board room of the companies, where the heads of departments met, and through Mr. J. W. Laws, who made the presentation, expressed their best wishes and esteem for their colleague. Mr. Seager has the hearty good wishes of the editors of the Electrical Review. May he have as much happiness in his new relationship, as he has had success in the excellent work accomplished by him in and through the *Tyneside Electrical Pioneer*.

On Monday afternoon last, Mr. J. S. Thomson, engineer and manager of the Fife Electric Power Co., was presented with a smoker's cabinet subscribed for by the staff on the occasion of his marriage, which was to take place yesterday. The presentation was made by Mr. A. D. Phillips, assistant engineer.

The Blackpool Corporation Tramway and Electricity Committee has recommended that the salary of Mr. Charles Furness, electrical engineer, be raised from £520 to £600, and that of Mr. H. Lancaster, tramway manager, from £300 to £350. This decision has been arrived at in consequence of the return of salaries paid in other towns showing that the Blackpool officials' salaries are below the average according to the amount of work done and profits made.

Tramway Officials.—Mr. W. H. Moorhouse, the present manager of the Barnsley tramways, has been appointed manager of the Llandudno and Colwyn Bay Light Railway.

Mr. C. J. Jewell, until recently with Messrs. W. T. Glover and Co., Trafford Park, Manchester, has been appointed resident engineer to the Wakefield and District Light Railway Co.

General.—Mr. Reginald P. Wilson, consulting engineer, of Westminster, is leaving London shortly for America, where he has business engagements which will occupy him for a few weeks.

Mr. Stephen Sellon, M.Inst.C.E., announces that Mr. Ernest M. Sellon, M.I.E.E., who has been associated with him in business for some time, is now a partner in his practice, which will be carried on as heretofore, but under the title of Stephen Sellon and Partners, at 36, Victoria Street, S.W.

Mr. Edward G. Acheson, of Niagara Falls, has been awarded the Rumford medal by the American Academy of Arts and Sciences for the application of heat in the electric furnace to the industrial production of carborundum, graphite and other new and useful substances. Mr. Acheson is the twenty-first person in the United States to receive this medal. Among others on whom it has been conferred are John Ericsson, George Henry Corliss, Henry A. Rowland, Samuel P. Langley, Thomas A. Edison, Charles F. Brush, and Elihu Thomson.

CHARGES FOR ELECTRICITY.

[FROM A LEGAL CONTRIBUTOR.]

Cases relating to the supply of electricity and the charges which undertakers may exact from consumers are not of frequent occurrence in English Courts. This is no doubt due to the fact that, as a general rule, undertakers are able to supply at rates much lower than the maximum which they would be allowed to charge by Act of Parliament. But there is one question in relation to charges which has arisen more than once, namely, what are the powers of the undertakers in relation to alternative methods of payment? Can they charge one consumer, who takes a large quantity one price, and demand increased rates from small consumers?

Sec. 20 of the Electric Lighting Act, 1882, provides that "undertakers shall not in making any agreements for a supply of electricity, show any undue preference to any local authority, company, or person, but save as aforesaid, they may make such charges for the supply of electricity as may be agreed upon, not exceeding the limits of price imposed by or in pursuance of the license, order, or special Act authorising them to supply electricity."

Upon reading this provision it might be thought that a company would be prevented from supplying except at a uniform rate to every consumer in their district; but this is not the case. A different meaning has, however, been placed upon the section. In Metropolitan Electric Supply Co. *v.* Ginder (1901), 2 Ch. 799, an intending consumer signed a form of request to an electric lighting company, subject to, *inter alia*, the following terms: (1) The consumer agrees to take the whole of the electric current required for the premises mentioned below from the company for a period of not less than five years. (2) The charge for electric energy to be 4½d. per Board of Trade unit. No quantity was specified, and there was no covenant by the company to supply, nor by the defendant to take any energy. Similar forms of request had been signed by other persons for different terms of years at different prices. The company afterwards supplied another consumer under contract for two years at 4d. per unit; but he was a large consumer who took his supply in the daytime, which was an advantage to the company. It was held that this did not amount to "undue preference" under Sub-sec. 19 and 20 of the Act of 1882 that the phrase "similar circumstances" which occurs in Sec. 19 of the Electric Lighting Act, 1882, included amount of energy consumed, the expense of supplying it and getting payment, uniformity of demand, and the fact that some consumers required energy by day and some by night, and that, unless all the circumstances were similar, agreements might lawfully be made for different terms and at different rates.

According to the principle involved in this case, it is obvious that the usual practice of granting special terms to those who take a supply for "power" purposes is conformable to the law. There is one other method of charging, the legality of which has not, so far as we are aware, been discussed in any English case. We refer to the method whereby the consumer is charged at a certain rate for the first few hundred units which he consumes, and at a lower rate for a supply taken subsequently. Is this method compatible with a charge to other consumers at a "flat" rate?

This point has been recently discussed in Australia in the case of Mayor of Melbourne *v.* Attorney-General of Victoria (3 Commonwealth Law Reports, p. 467). By Sec. 39 of the Electric Light and Power (Victoria) Act, 1896 (No. 1,413) it is provided that—"The undertakers shall not, in making any agreements for a supply of electricity, show any preference to any council, company, or person, and the charge for such supply shall be uniform throughout such area, so that each council, company, or person shall be supplied at the same price and not less than any other council, company, or person, but such price shall not exceed the limits of price imposed by or in pursuance of the order authorising them to supply electricity." In the case in question undertakers had two scales under which they charged consumers for the supply of electricity, and all consumers had the option of which rate they would select. Under one scale, called the "flat rate," consumers were charged for the actual quantity of electricity supplied at the uniform rate of 4½d. per unit. Under the other scale, called the "maximum supply rate," consumers were charged at the rate of 7d. per unit, as to such portion of the electricity supplied to them as was equal to a consumption for a period of 45 hours per calendar month at the highest rate of consumption during the month, and as to the remainder of the electricity so supplied during the month at the rate of 2d. per unit. It was decided by the Court of Appeal that the charges were lawful, and that the section in question was directed to a preference between persons supplied with electricity, and under it the charge for the supply of electricity might be uniform, although there were alternative scales of charges. Thus, under one of those systems, the price for every unit supplied might be uniform, while under another a larger price might be charged for a specified quantity first supplied and a smaller price for the remainder, provided that all the consumers have the opportunity of electing on which scale they will be charged.

Seeing that the provisions of the Victorian Statute which were discussed in the above case are practically the same as those of our own Electric Lighting Act, it is apprehended that this decision would be upheld in an English court of law.

NEW COMPANIES REGISTERED.

Wisbech Electric Light and Power Co., Ltd. (93,430).—This company was registered on May 18th, with a capital of £25,000 in £1 shares, to adopt an agreement with the National Electric Construction Co., Ltd., to take a transfer of the undertaking authorised by the Wisbech Corporation Electric Lighting Orders 1901 and 1906, and to carry on the business of suppliers of electric light and power, electrical engineers, metal workers, contractors for the supply of electric plant, &c. The first subscribers (each with one share) are:—J. T. Jervis, M.I.C.E., Queen Anne's Chambers, S.W.; W. B. Cownie, 22, King's Avenue, Muswell Hill, N., general manager; R. Watson, 26, Ranelagh Avenue, Barnes, S.W., accountant; L. D. H. Lamb, 30, Grasmere Road, Muswell Hill, N., secretary; W. C. Bishop, 8, Ulysses Road, West Hampstead, N.W., clerk; E. A. Bond, 9A, Cookham Mansions, Munster Park, S.W., clerk; and H. W. Willis, 2, Clausentum Road, Southampton, engineer. No initial public issue. The number of directors is not to be less than three or more than seven: the first are W. B. Cownie, F. E. Stanley and J. T. Jervis; qualification, £100; remuneration £25 each per annum (chairman £50) and 10 per cent. of the surplus profits available for distribution after 5 per cent. has been paid on the ordinary shares, divisible. Registered office, 3, Queen Anne's Chambers, S.W.

Caribbean Anglo-Colombian Cable Co., Ltd. (93,464).—This company was registered on May 24th, with a capital of £100,000 in £1 shares, to carry on the business of a telegraph and telephone company in all its branches, to construct, lay down, install, maintain and work submarine and land cables and wires, &c. The first subscribers (each with one share) are:—M. Ross, 43, Deronda Road, Herne Hill, S.E., stenographer; A. E. Cadby, 128, Clapham Road, Stockwell, S.W., clerk; A. R. Bennett, 16, Digby Road, Brownswood Park, N., accountant; H. G. Rushen, 164, King Henry's Road, South Hampstead, N.W., clerk; W. H. C. Cory, 67, Cavendish Road, Finsbury Park, N., secretary; A. Borer, 91, North Hill, N., clerk; and W. Postlethwaite, 119, Mildmay Park, N., clerk. No initial public issue. The number of directors is not to be less than three or more than seven; the subscribers are to appoint the first; qualification, two shares; remuneration (except managing director), £300 each per annum and £100 extra for the chairman. Registered office, 84, Bishopsgate Street Within, E.C.

Reed's Electrical Co., Ltd. (93,493).—This company was registered on May 25th, with a capital of £8,000 in £1 shares, to carry on the business of electricians, electrical and mechanical engineers, suppliers of electricity for light, heat, motive power or otherwise, manufacturers of, and dealers in, electrical apparatus, &c., and to adopt an agreement with W. Ruddock. The first subscribers (each with one share) are:—W. M. Purkis, 18, Mayfair Avenue, Ilford, traveller; Florence Hull, 20, Vicarage Mansions, Abbotsford Avenue West Green, N., shorthand writer; W. Renshaw, 246, Hyde Road, West Gorton, Manchester, plumber; L. R. Erlynne, 21, Calthorpe Street, W.C., clerk; W. Ruddock, 333, Thorold Road, Ilford, electrical engineer; C. J. Bailey, 257, Lynton Road, Bermondsey, clerk; and J. T. Hayter, 41, Bishopsgate Street Within, E.C., accountant. No initial public issue. The number of directors is not to be less than two or more than seven; the first are B. Reed (chairman), and W. Ruddock; qualification, £100; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

T. A. W. Clarke, Ltd. (92,610), (electrical engineers, Leicester).—A debenture dated May 2nd, 1907, to secure £1,000, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: J. T. Clarke, Havelock Works, Leicester.

Newcastle and District Electric Lighting Co., Ltd. (28,022).—Particulars of £100,000 5 per cent. second debentures created by resolution of February 1st, 1907, have been filed pursuant to Sec. 14 (4) of the companies' Act, 1900. Property charged: The company's undertaking and property, present and future, including uncalled and unpaid capital. No trustees.

Madras Electric Supply Corporation, Ltd. (87,409).—A trust deed dated October 17th, 1906, executed pursuant to a trust deed dated February 22nd, 1906 (already registered), securing £25,000 "Construction" debenture stock, was registered on May 17th, 1907, by permission of the Court. Property charged: Licence granted by the Government of Madras, under the Indian Electricity Act, 1903, known as the "Madras Electric Licence, 1905," certain land, with buildings, fixed plant, machinery and appurtenances, at Verpery, Madras, and the company's undertaking and property, present and future, including uncalled capital. Trustees: C. C. Cave, 13, Cranley Gardens, S.W., and C. F. Tufnell, Waterdone Manor, Kenley, Surrey.

Willey & Co., Ltd. (79,618).—This company's annual return was filed on April 13th, when the entire capital of £100,000 in 25,000 preferred and 75,000 ordinary shares of £1 each, had been taken up. £7 had been received and £99,993 is considered as paid. Mortgages and charges: £20,000.

Mann, Egerton & Co., Ltd. (83,780).—This company's annual return was filed on March 27th, when 11,669 preference and 6,007 ordinary shares had been taken up out of a nominal capital of £40,000 in 25,000 preference and 15,000 ordinary shares of £1 each. £1 per share has been called up on seven ordinary and 5,500 preference, and £5,507 has been received. £12,169 is considered as paid on 6,169 preference and 6,000 ordinary. Mortgages and charges: £10,000.

Union Electric Co., Ltd. (71,115).—This company's annual return was filed on April 29th, when 24,250 shares had been taken up out of a nominal capital of £25,000 in £1 shares. £1 per share has been called up on 4,250 and 1s. per share on 19,500 shares, and £5,225 has been received. 500 shares are considered as fully paid. Mortgages and charges: Nil.

Newcastle and District Electric Lighting Co., Ltd. (28,022).—This company's annual return was filed on March 21st, when the entire capital of £300,000 in £10 shares had been taken up. £9 per share has been called up and £267,274 has been received, leaving £2,726 in arrears. Mortgages and charges: £150,000.

Scottish House-to-House Electricity Co., Ltd. (29,232).—An additional charge for £500 and 6 per cent. interest was endorsed on a charge dated March 31st, 1904, on May 3rd, 1907. Property charged: The company's undertaking and property, present and future, including the Coatbridge and Airdrie undertakings, interests in orders and agreements, uncalled capital, &c. Holders: County of London Electric Supply Co., Ltd., Moorgate Court, E.C.

British Electric Transformer Co., Ltd. (76,351).—This company's annual return was filed May 3rd, when 30,490 preference and 9,399 (? 69,399) ordinary shares had been taken up out of a nominal capital of £125,000 in 50,000 preference and 75,000 ordinary shares of £1 each. £1 per share has been called up on 39,889 shares, resulting in the receipt of £39,904 12s. 6d., including £15 12s. 6d. paid on 25 forfeited shares. 60,000 ordinary shares are considered as fully paid. Mortgages and charges: Nil.

Guildford Electricity Supply Co., Ltd. (36,725).—This company's annual return was filed on April 11th, when 9,901 preference and 2,782 ordinary shares had been taken up out of a nominal capital of £55,000, in 25,000 preference shares of £1 each and 6,000 ordinary shares of £5 each. £23,813 has been received, including £2 paid on two forfeited shares. Mortgages and charges: £25,000.

CITY NOTES.

Electric Traction Co., of Hongkong, Ltd.

THE directors' report for the year ended December 31st, 1906, shows that the substantial progress anticipated has been fully borne out, resulting in a net profit for the year of £6,567. Of this, £6,000 has been set aside in respect of depreciation, which will be used for repairs and renewals as occasion arises; the balance of £567 is to be carried forward. During the year the weekly traffic receipts have, almost without exception, shown considerable increases over the corresponding periods of 1905. This progress is still being continued, and the board consider that, even with the existing number of cars, the maximum limit of passengers has not been reached. In September last, a typhoon of exceptional severity visited Hongkong, and, considering the widespread destruction of life and property caused thereby, the company was extremely fortunate to escape with but slight damage. The Colonial Government assented, in the course of the year, to the tramway rights, hitherto held by the Hongkong Tramway Electric Co., Ltd. (the Ordinance Co.), in which this company held all the shares, being transferred to this company. In consequence, the Ordinance Co. has been wound up, and all rights, property, &c., are now vested in this company, subject to the charges thereon, constituting the security for the debenture-holders.

STATEMENT OF AVERAGES, &C., FROM JANUARY 1ST TO DECEMBER 31ST, 1906.

Miles of street tramway	about 9¼
Number of cars in stock December 31st, 1906 ...	36
Passengers carried (*i.e.*, tickets issued)	8,084,901
Car-mileage run	1,137,727
Earnings per car-mile	8·66d.
Expenses per car-mile	5·21d.
Average fare per passenger	1·21d.

The meeting of the company was held on Wednesday at 19, St. Swithin's Lane, Mr. E. C. Morgan presiding.

The CHAIRMAN, in proposing the adoption of the above report, said that the accounts showed substantial improvement in the position of the company as compared with last year. The receipts had shown steady increases during the year under review, and these increases were continuing in an even more satisfactory ratio. Doubts were expressed at the last meeting as to the efficiency of the management, but, as the result of somewhat drastic measures taken by the board, a great change for the better had taken place in the local administration, and he thought he might now fairly say that the service was run in a thoroughly workmanlike manner, and that there were now practically no complaints from the public. The accounts showed increases under most heads of expenditure, but these were only such as might be reasonably looked for, having regard to the additional amount of work done, and to the necessity for greater outlay for maintenance by reason of the wear and tear of the plant and roadway, which naturally needed very little during the first year. The loss sustained on the subsidiary coinage figured for no less a sum than £2,378, against £486 for the year 1905. All of those who were acquainted with the Settlement were aware of the serious losses sustained by the depreciation on the small coins which were principally imported from the mainland, and which were used for small payments throughout the Colony. The remedy could only be supplied by Government, who had, so far, taken no steps, which it was obviously necessary they should do, to check the currency of a debased coinage. In a business such as theirs, where the payments were all in small amounts, they could not refuse to take the coins tendered, as, if they did so, they would simply drive away their passengers, who in most cases had no other coins, and they therefore had to take them and dispose of them, *quantum valeant*, with the result that they were mulcted in an amount which represented about 6 per cent. of their receipts. This percentage of loss showed a very considerable increase over that suffered last year, and there seemed no reason to suppose that the limit had been reached. Allusion was made in the report to the severe injury caused to the settlement by a typhoon during the year. Their company fortunately escaped with little direct loss, but a vast amount of damage was done to the small craft by which much of the traffic along the sea front had hitherto been carried. This gave a considerable impetus to their traffic, as many of those who had been accustomed to travel by water were compelled to make use of their cars, and, having once adopted this means of locomotion, had found the convenience so considerable that they had not reverted to their former methods. It was suggested to the board that they should, in the absence of the boats, arrange a system of carrying goods on their lines. Experience, however, had shown that the carriage of goods on tramways, having regard to the different conditions required for the carriage of goods and passengers, had not been successful, and the directors considered that they would best serve the interests of the company by devoting their attention to the development of the passenger traffic, a course which had been attended with success. Further development of the traffic would become practicable when the docks, which were now under construction at Shau-ki-wan, were completed, and this, it was said, would be the case, at all events in part, towards the end of the year. The line from Causeway Bay to Shau-ki-wan constituted about one-third of the system where, up to the present, they had been merely marking time, and it was evident that when this length of line became of utility to the public they might reasonably look for a considerable increase in takings. Their improved receipts had enabled them to make a commencement with a depreciation and renewal fund, which they would continue to strengthen, so as to form a substantial amount to serve in case of need. It would have been their desire to invest this at once outside their business, so that it might be immediately available if wanted, but their capitalisation made no provision for working capital, and at present they had only their reserve to use for this purpose. They would, however, at the earliest possible moment arrange for the establishment of a separate fund. In conclusion, he said that the undertaking was in a sound position, and gave promise of improvement and steady growth, having now become thoroughly popular, and recognised as filling in the most convenient and economical manner, the requirements of the public.

Mr. ROBERT MILLER seconded the motion, and the report was adopted.

British Aluminium Co., Ltd.

THE directors' report says that the profit for the year 1906 transferred to appropriation account is £155,024. To this has to be added £3,880 brought forward, making £158,904; debenture stock and debenture interest absorb £29,328; the balance of expenses of issue of Loch Leven debentures and new capital, £19,772, has been written off, and in addition £7,829 has been applied in reduction of goodwill account. The last-named two sums, amounting together to £27,601 have been utilised in purchasing and cancelling £28,800 of the company's debenture stock. 3,455 funding certificates have been purchased and cancelled at a cost of £14,534. There thus remains available £87,440. It is proposed to write off for depreciation £20,000. After paying dividends on the "A" preference and preference shares, £3,019 on funding certificates, and 5 per cent. on the conversion shares, there is 7 per cent. paid on the ordinary shares, absorbing £9,006, and £34,549 is carried forward. During the year progress has been made with the development of the Loch Leven power scheme. Under the contract with Sir John Jackson, Ltd., the hydraulic portion of the work has to be finished by August 15th, 1908, by which date, under contracts made with several firms, all the generating plant should be installed in the power house. By that date also the aluminium factory is expected to be erected and equipped. The erection of workmen's dwellings in the village of Kinlochleven is proceeding rapidly. With a view to obtaining an increased production of aluminium prior to the completion of the Leven works, the board acquired a partially-developed power at Stangfjord, in Norway, and took steps to develop some 3,000 H.P. at Leven, which latter can be utilised without interfering with the progress of the main scheme. As a result, it is expected that the production of aluminium will commence in Norway in a few weeks' time, and at Leven in the autumn. The board has also acquired the concessions for a water power of considerable magnitude at Orsières, in Switzerland, and intends to proceed with the construction of the works without delay. Already the board has commenced the construction of a railway line to connect Orsières with the main line of the Swiss Federal Railways at Martigny. These extensions involve a large expenditure. To meet this and other outlays, the share capital of the company has been increased by £600,000 by the creation of 40,000 6 per cent. "A" preference shares of £5 each, and 40,000 "1908 conversion shares" of £10 each. It is intended to allot the latter on the 11th prox. *pro rata* to the registered holders on that date of the 7 per cent. preference, ordinary and existing conversion shares.

In 1895, on the occasion of the acquisition by this company from the Société Anonyme pour l'Industrie de l'Aluminium de Neuhausen of the English patents for the manufacture of aluminium, the latter company undertook to furnish to this company detailed information as to the process then used at its Neuhausen works, and this company, in return, undertook only to use such information in works in the United Kingdom or in the Colonies or Dependencies of the United Kingdom. The Neuhausen Co. recently contended that this company could not manufacture aluminium abroad with-

out infringing that agreement. As this company was about to enter upon the manufacture of aluminium upon the Continent, an agreement was come to with the Neuhausen Co. to end all outstanding provisions of the 1895 contract upon this company paying to the Neuhausen Co. the sum of £100, and engaging for a maximum period of 10 years from January 1st, 1907, not to use or permit to be used any part of the Orsières water power for the production of aluminium.

Mr. Ernest E. Sawyer, M.A., M.Inst.C.E., has been elected a director of the company.

Brush Electrical Engineering Co., Ltd.

THE meeting was held on Thursday of last week at Salisbury House, London Wall. Lord Vaux of Harrowden presided, and in proposing the adoption of the report (see ELECTRICAL REVIEW, May 17th, page 817) said he regretted that the balance-sheet now before them compared unfavourably in some respects with that of the previous year, but he thought he would be able to show them that the situation so far as the manufacturing and trading aspects were concerned, arose from exceptional causes. The gross profit on trading, &c., was £65,802, as compared with £73,929 for 1905, while interest and profit on sales of securities realised only £4,755 as against £8,001. On the opposite side the general charges showed small increases in some of the items and reductions in others, the net result being an economy of about £500. The expenditure for maintenance of plant and buildings had increased to £8,760 as compared with £7,402 for the previous year due partly to the fact that a large proportion of the machinery at the works had been run at high pressure, and for long hours, and also to a natural increase of the disbursements under that head following on additions to buildings and plant. Turning to the balance-sheet it would be seen that the property account had been increased by £22,822 spent on additions during the year, and that had all been met out of the current position. The bulk of that expenditure had been for an additional shop equipped for the construction of steel goods, wagons of large capacity, and for steel rolling stock generally. They did not get the full benefit of that expenditure in 1906, but fully expected that it would be remunerative, as they were now in a position to efficiently handle contracts for the class of work referred to, for which there was an increasing demand. The item of patents and goodwill remained at £181,397. Under the head of stock the figure had increased from £161,511 to £240,073. That increase was represented chiefly by additional work in progress, and that was one of the characteristics of the business to which he would refer later. Debtors represented £193,807, as against £147,790 at December 31st, 1906. The investments had been reduced from £170,534 in 1905 to £164,522, and they would see that the auditors' certificate called attention to the fact that the investments had largely depreciated in value. It had always been the practice to enter them at or below cost price, and it would be for the shareholders to say whether they desired any special steps taken to deal with the situation. On the debit side of the balance-sheet the amount of loans and overdraft from bankers and others had gone up from £31,423 to £93,167, an admittedly large increase, but which was more than accounted for by the increased work in progress. The item of creditors had also advanced from £62,762 to £159,375; that was owing to a combination of circumstances, but since December it had been considerably reduced. The general reserve fund had been reduced by £20,483, of which £6,890 represented losses accumulated in connection with their Australasian branch and part of the expenses of closing that branch. That branch was originally established in 1889, when the Brush Co. absorbed the business of the Australasian Electric Power and Storage Co., and for a time paid its way, but of late years, owing to increasing competition, the results had been unsatisfactory. Last Autumn, Mr. Broadhurst, the secretary, went out and investigated the business locally, with the result that it was decided to close the branch, and to make arrangement for the continuation of the company's business in Australasia by the appointment of agents. During the branch's existence there had been an accumulation of certain stocks which had not realised book values, and there had also been other expenses to deal with in closing the branch. Those items did not properly come into the company's operations for 1906, and the board had therefore decided to debit them to the general reserve fund, which had been built up during the last few years to meet such contingencies. For the future the company's business in Australasia would not involve them in any serious local risks nor the maintenance of an expensive management and staff on the other side, and they might anticipate though there would not be so large a business done, that it would at least show some margin of profit. The other amount of £13,593 debited to the general reserve fund was for excess cost, experimental work, and preliminary expenses of new manufactures. Owing to the fact that a large number of the principal cities and towns of the United Kingdom had now completed the equipment of their electric tramway system, there had been a considerable diminution in the demand for tramway rolling stock, which was one of their most important lines of manufacture in the past. The directors had therefore had to find other work to keep the rolling stock side fully occupied, and they had turned their attention to the allied industry of main line rolling stock, and had secured important contracts which had turned out satisfactory, both alike to customers and the company. Work of that kind, however, took much longer than the lighter tramcar construction, and the lock-up of their capital was a very serious matter, and they had therefore been compelled to borrow, and as they knew, the condition of the money market was all against them. Furthermore, in handling work that was in a measure new and unfamiliar to them, they had a good deal to learn, and the initial costs which had been incurred would, in the future, be avoided. They had also been considerably hampered by a strike of workmen in their car-building shops. It was a great disappointment and source of regret to the directors that that strike should have occurred, because their relations with their men had previously been of a very cordial and harmonious character, and the exodus of a large number just at a time when the factory was working at great pressure, caused general confusion and serious dislocation of the business. Although steps were at once taken to fill the men's places, it was not at once possible to fill efficiently the place of so large a number of skilled men, and they had therefore been, for a prolonged period, working under serious disadvantage. They had also been giving their attention to the manufacture of commercial motor-vehicles, and they had taken up a lease of the works put up by the British Automobile Development Co., just adjoining their works at Loughborough, and were turning out motor-omnibuses and other types of commercial vehicles, for which there was now a regular and increasing demand. Certain preliminary expenses in connection with these vehicles had been included in the general reserve fund, and although it would have been permissible to have written off these expenses and the excess cost of construction of the main line rolling stock over a term of years, he thought they would agree with him that it was better to extinguish the item by at once debiting it in full against the reserve fund. As regarded the electrical engineering departments, he was pleased to say that they had made substantial progress in widening the markets for their steam turbine and reciprocating engine generating sets. They had built power plants of that description in many sizes, and now had them in successful operation in many electric light, power and traction stations, both in this country and abroad. Competition was, however, very great, and in addition to being hampered by the free admission of Continental and American products into our markets, the producing power of the English factories was far in excess of the demand. The result was that the competition was very severe, and the successful competitor often had cause for regret, for it generally meant that he had taken the work at too low a price. That unsatisfactory state of affairs had led them to pay more attention to foreign contracts, and they had met with a gratifying measure of success in that direction, recent examples of their work now being in operation in South Africa, South America, New Zealand, India, &c. Foreign work, however, entailed greater risks, both as regarded the initial expense of obtaining the contract and from a financial point of view. It generally meant that one or more of the company's responsible officers had to visit the country so as to settle the arrangements, and should the company not secure the contract, the expenses that had to be written off were very much heavier than if the work was being done at home. He simply mentioned these facts so that they could understand the difficulties under which they were working, and without expressing any opinion as to the merits of Tariff Reform, it did seem a little anomalous to him, that by reason of foreign competition English manufacturers should be compelled to seek a large proportion of their trade abroad. In conclusion, he would remind them that competition was still very severe, and consequently the margin of profits in many of their manufactures was small. The demand for tramcars had largely fallen off, and it was especially on that side of the work that they were able, in the past, to secure adequate profits. They had great hopes that now a good start had been made in main line rolling stock, for which the existing shops were well adapted, they would find a small margin of profit, and that freedom from labour troubles and the strenuous exertions of the officers and staff, which he could assure them were not being spared, would result in satisfactory profits on the capital invested.

Mr. W. L. MADGEN seconded the motion.

Mr. CATHCART said that last year they thought that they had turned the corner, but he was afraid that they were now in a worse position. They were about £10,000 behind in their net profits, and various other items of the balance-sheet were not so satisfactory as they were. With regard to the Australasian business, he noticed that there was still a sum of £12,000 due, and he would like to know whether the directors hoped to realise the whole of that, or whether it would be necessary to write anything off. He was glad to be able to congratulate the directors that at last they had listened to the voice of the auditors about taking their investments at ridiculous prices. It was evident from the report of the auditors that £30,000 of their investments were gone, and in his opinion the only possible chance of the company ever paying a satisfactory dividend would be for the directors to write down the capital.

Mr. E. GARCKE remarked that he thought the directors deserved sympathy in the troublous period through which they had passed last year. Of course he, in common with other shareholders, felt disappointed at receiving no dividend, but he felt sure that very few of them realised what an enormous amount of work was necessary to hold up the company, and to carry it on under the exceedingly arduous conditions which had confronted the board during the past year. No doubt some mistakes had been made with the best possible intentions. The board had made an endeavour to improve the position of the company by doing a larger volume of trade with a smaller proportion of profit. In his opinion the right policy for the company to pursue was to endeavour to do the smallest amount of work necessary to carry on the business, and to do that business at a relatively large profit, but until general conditions improved, it was very doubtful whether electrical manufacturers in this country could secure the full profit to which they were entitled. He was recently in Australia, and he found that the Americans and the Germans, by the aid of subsidies from the steamship companies and the Government, instead of withdrawing their agents, were increasing them, and they were able to compete with the English manufacturers in

a very serious way. Unfortunately, English firms did not make sufficient profits at home to enable them to incur the necessary expenditure for pushing their business to the extent that was necessary, and that brought him to the point that he thought all shareholders in industrial concerns should consider, and that was the general industrial conditions of this country in regard to the fiscal question. That question should be considered by them, not from a party point of view, but from the point of view of men of business, and he could not help thinking that if they did that they would see many ways by which their investments in industrial concerns could be very materially improved. He agreed with the suggestion that the directors ought to take into consideration the question of adjusting the capital account. If they could only improve the general conditions under which industrial undertakings in this country were carried on, he had no reason to doubt but that the Brush Co. would occupy a very promising and lucrative position.

The CHAIRMAN, in reply, said that with regard to the £12,000 due from the Australian branch, that was largely in the nature of debts which were at the present moment being collected. Since the compilation of the balance-sheet, £2,400 had been received, and they had every reason to suppose that they would receive further substantial amounts. They also had some stock there which would be realised at the best possible prices. With regard to the patents and goodwill, there was only one way of dealing with that, and that was by writing down the capital. The board had had the matter under consideration, and they would have to seriously consider during the next few months what was the best way of dealing with it, and at the same time they would also deal with the question of writing down their securities.

The report was then adopted

The Report of the General Electric Co. (U.S.A.).

THE issue of the *Electrical World* that is just to hand quotes figures and statements from the fifteenth annual report of the General Electric Co. in a remarkable year of growth, activity and prosperity. The company did a business of over $60,000,000 in the 12 months, $17,000,000 more than in 1905, or an increase in shipments of about 40 per cent. The sales this year have been 50 per cent. greater than in 1906, and if such growth continues, additional capital will be required. The net profits of the company were $8,427,842 net. Out of this dividends were paid to the amount of $4,344,342. From this was written off $999,999 on account of patents, franchises and goodwill, and $3,083,501 was carried to surplus, making, with previous surplus, a total on January 31st, 1907, of $15,110,796.

As to gross business, this during three years was:—

Year ending January 31st.	Amount billed.	Orders received.
1905	$39,231,328	$35,094,807
1906	43,146,902	50,044,272
1907	60,071,883	60,483,659

"Orders received" include only apparatus manufactured by the company, and not such items as services of experts, labour of installation, freight and transportation, supply of material, boilers, engines, &c., of outside manufacture, and bare copper wire. All these items are included in "Amount billed." In the last ten years the amounts billed have increased from $12,540,994 in 1896, to $60,071,883 in 1906, an average increase of 17 per cent. per year.

During the year turbo-generators of an aggregate 350,000 H.P. were sold, and large numbers were shipped all over the world. On April 1st the company had already put 110 multiple unit electric trains and 30 electric locomotives in use on the New York Central Railroad. During the year supplies sales increased 35 per cent., and no fewer than 40,365 stationary motors, aggregating 565,000 H.P. were sold. Outside of contracts, no fewer than 235,028 supply orders were received, or 783 per working day. Sales of large apparatus increased, and show the same tendency as heretofore towards the larger sized units. The maximum sizes in various lines are:—

Units.	Nominal rating.	Overload capacity.
Turbo-alternators	9,000 KW.	13,500 KW.
Water-wheel generators ...	7,500 KW.	11,250 KW.
Direct-current generators...	2,700 KW.	4,000 KW.
Induction motors	6,000 KW.	9,000 KW.
Transformers	7,500 KW.	11,250 KW.

The particulars of factories and factory employés during the last three years are:—

	Floor space.	Employés.
1905	4,100,000	18,000
1906	4,350,000	22,500
1907	4,770,000	28,000

In all the factories important extensions are planned or under execution. At the Harrison works, a building with 60,000 sq. ft. has been put up for the manufacture of high-efficiency metallic filament lamps.

"The size and voltage of transformers for use in long distance transmission work continues to increase. We are now building on order a number of transformers of 7,500 KW. capacity, for operation at 104,000 volts. Our high-tension switching apparatus has been still further developed during the year; one notable instance has been the design and successful testing of a switching device for 100,000-volt operation. Our engineers have completed the design of a line of direct-current railway motors containing important novel features. Practical tests have shown these new motors to be superior to existing standards in economy, commutation, and ability to operate at higher and more economical voltages. An interesting and important application of electricity is found in the reduction of metals. During the present year we have sold to one customer for use therein 28 machines of a total capacity of 74,000 KW. These machines are the largest direct-current generators in existence, were especially designed by us for the purpose, and those already completed have proved to be entirely successful. The vertical shaft design which has proved so successful in our large turbines has been applied to the design of motor-generators and rotary converters. This vertical arrangement effects a considerable saving of space and money, and is particularly desirable for use in sub-stations in large cities. We have sold a number of such vertical sets for operation in Chicago and other places. Electric motors in industrial establishments continue to increase both in numbers and in variety of applications. An interesting case, involving the use of very large motors of special design, is that of driving rolling mills in the manufacture of steel. We have several contracts in which the motors for driving the mills average about 10,000 H.P. capacity each."

Lewes and District Electric Supply Co., Ltd.

THIS company held its annual meeting at Donington House on Monday. The report for 1906 showed that the capital expenditure during the year was £736, making, with £25,498 previously expended, a total of £26,235. The gross revenue amounted to £2,047, being an increase of £90. The expenditure, including £213 for interest on temporary loans, amounted to £2,069, leaving a loss for the year of £21. Deducting this from the sum of £103 brought forward, there remains a balance of £81, which is carried forward. In the early part of the year the battery depreciated rapidly, and caused a large increase in the working costs. It was decided to renew the plates, and the work was carried out in June. Since then the working expenses have shown a satisfactory reduction. The cost of this renewal—viz, £227—has been charged against the year's revenue. The demand for electricity continues to increase satisfactorily. The installations connected to the mains at December 31st last represented a demand equivalent to 9,499 8-C.P. lamps, an increase of 14 per cent.; 154,911 units were generated and 110,646 sold. The total maximum demand was 140 KW.

Leamington and Warwick Electrical Co., Ltd.—This company's meeting was held at Donington House on Thursday last week. The report then presented showed that the capital expenditure during 1906 was £13,801, of which £11,207 was incurred for the electric tramways reconstruction and equipment, and £2,593 in connection with the power station and equipment for the supply of electricity. The funds necessary had been advanced by the B.E.T. Co. The amount owing to that company at January, 1906, was £66,344, and this was reduced by the issue to that company of 5,174 ordinary shares at par. The debt now stands at £28,035, and to discharge it, it is proposed to make an issue of debentures. The working accounts show credit balances of £5,179 from traction and £208 from electric supply. There was available for distribution a total amount of £4,581, and the directors recommended that this should be applied as follows:—To depreciation and reserve account (raising it to £4,000), £500; dividend, 4 per cent. on the ordinary shares, leaving £1,258 to carry forward. The tramway receipts had increased by £2,598 over those of the preceding year, while the power and running expenses were £125 less. Payments to local authorities and cost of repairs had increased, but these items of expenditure were low in the preceding year, owing to the tramways being under reconstruction during part of the year. Inclement weather caused a falling off in the receipts. The supply of electricity had progressed, and the number of installations connected was 58, exclusive of the tramway load, and was equal to 2,256 8-C.P. lamps, compared with 1,549 8-C.P. lamps at December, 1905.

Bombay Telephone Co.—The annual meeting of this company was held at the offices in Bombay last month, Mr. Gordhandas Khattau presiding. A dividend at the rate of Rs. 1·8 per share, equal to 6 per cent., was declared.

Venezuela Telephone and Electrical Appliances Co., Ltd.—According to the *Financial Times*, meetings of the holders of first and second mortgage debentures were to be held yesterday to consider resolutions authorising the creation and issue of prior lien debentures to an aggregate amount of £30,000 (6 per cent. per annum), secured by a first charge on the undertaking and assets in priority to the charge of the existing first mortgage debentures, the date for the repayment of the existing first mortgage debentures now outstanding to be postponed until October 1st, 1925. The money is required for the conversion of the telephone system into a continuous circuit and for the electrification of the tramways.

Electricity Supply Co. for Spain, Ltd.—The secretary has issued a circular giving numbers of 6 and 7 per cent. mortgage debentures that have just been drawn for repayment at par. The 6 per cent. bonds amount to £9,000 and the 7 per cent. to £5,000.

Stock Exchange Notices.—Applications have been made to the Committee to allow the following securities to be quoted in the Official List:—

Kalgoorlie Electric Power and Lighting Corporation (1906), Ltd.—100,000 ordinary shares of 10s. each, fully paid, Nos. 175,001 to 275,000; and 150,000 preference shares of £1 each, fully paid, Nos. 1 to 150,000, in lieu of the preferred shares of the Kalgoorlie Electric Power and Lighting Corporation, Ltd.

MARKET QUOTATIONS.

Wednesday, May 29th.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	" Nitric	per cwt.	22/-	..
a	" Oxalic	per cwt.	32/-	..
a	" Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	" "	per ton	£30	..
a	Bleaching powder	per ton	£5 10	..
a	Bisulphide of Carbon	per ton	£18	..
a	Borax	per ton	£15	..
a	Copper Sulphate	per ton	£33 10	..
a	Lead, Nitrate	per ton	£33 10	..
a	" White Sugar..	per ton	£35	..
a	" Peroxide	per ton	£32	..
a	Methylated Spirit	per gal.	2/6	..
a	Potassium Bichromate, in casks	per lb.	3½d.	..
a	Potash, Caustic (75/80 %) ..	per ton	£20	..
a	" Chlorate	per lb.	3½d.	..
a	" Perchlorate	per lb.	9d.	..
a	Potassium Cyanide	per lb.	7½d.	..
a	Shellac	per cwt.	220/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	" Recovered	per ton	£5 10	..
a	" Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	" Chlorate	per lb.	3½d.	..
a	" Crystals	per ton	£3 5	..
a	Sodium Bichromate, casks ..	per lb.	3d.	..
a	" Cyanide (basis 100 %) ..	per lb.	7d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£200	..
b	" Wire, in ton lots ..	per ton	£220	..
b	" Sheet, in ton lots ..	per ton	£210	..
p	Babbitt's metal ingots	per ton	£60 to £195	Dec.
c	Brass (rolled metal 2" to 12") basis	per lb.	11¼d.	..
c	" Tube (brazed)	per lb.	1/0½	..
c	" " (solid drawn)..	per lb.	11¼d.	..
c	" Wire, basis	per lb.	11d.	..
c	Copper Tubes (brazed)	per lb.	1/2	..
c	" " (solid drawn) ..	per lb.	1/2½	..
g	Copper Bars (best selected) ..	per ton	£120	£2 inc.
g	Copper Sheet	per ton	£122	£2 inc.
g	" Rod	per ton	£120	£2 inc.
e	" (Electrolytic) Bars ..	per ton	£117	..
e	" " Sheets ..	per ton	£125	..
e	" " Rod ..	per ton	£121	..
e	" " H.C. Wire	per lb.	1/2	..
f	Ebonite Rod	per lb.	8/8	..
f	" Sheet	per lb.	8/-	..
n	German Silver Wire	per lb.	1/8	..
h	Gutta-percha, fine	per lb.	5/3 to 6/6	..
h	India-rubber, Para fine	per lb.	4/8½	Dec.
i	Iron, Charcoal Sheets	per ton	£18	..
i	" Pig (Cleveland warrants)	per ton	69/11	7/2 inc.
i	" Forgings, according to size	per ton	From £11	..
i	" Scrap, heavy	per ton	47/6 to 50/-	..
i	" Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£20 12 6 to £20 15	..
g	" " Sheet	per ton	£21	Inc.
m	Manganin Wire No. 28	per lb.	8/	..
g	Mercury	per bot.	£7	..
d	Mica (in original cases) small ..	per lb.	6d. to 1/-	..
d	" " " medium	per lb.	2/6 to 4/-	..
d	" " " large ..	per lb.	4/6 to 8/6	..
p	Phosphor Bronze, plain castings	per lb.	1/4½ to 1/6½	..
p	" rolled bars & rods	per lb.	1/5½ to 1/6½	..
p	" " strip & sheet	per lb.	1/6 to 1/10	..
o	Platinum	per oz.	100/	..
e	Silicium Bronze Wire	per lb.	1/3½	..
s	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
	" " in bars		£15 to £40	..
g	Tin, Block (English)	per ton	£193 to £194	£1 inc.
n	" Wire, Nos. 1 to 16	per lb.	2/3½	..
p	White Anti-friction Metals—			
	"White Ant" brand	per ton	£56 to £80	Dec.
k	Zinc, Sh's (Vieille Montagne bnd.)	per ton	£30 10	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

Prospectuses.—*The United Electric Light and Power Supply Co., Ltd.*—This company has obtained an electric lighting concession in Guimaraes, an industrial centre with a population of 15,000, in Portugal, and has this week been inviting applications for 12,170 shares of £1 each. The other shares already taken up were 2,830, and 6 per cent. debentures, amounting to £2,800, have been issued. The directors include one Wright Taylor, electrical engineer, Aked Street, Ardwick, Manchester, and three other Manchester men. The registered offices are at 184, Stockport Road, Manchester.

The *Times* says that an issue is being arranged of £200,000 *Shawinigan Water and Power Co.* 4½ per cent. bonds at 90.

STOCKS AND SHARES.

Tuesday Evening.

Some indefinable sense, or presentiment, of ill appears to hang over almost every department of the Stock Exchange. What it is, nobody knows. The concatenation of adverse circumstances that followed inevitably upon our own Boer War, the Russo-Japanese struggle, and the extravagance of omnivorous municipal borrowers has gone far to paralyse public confidence in Stock Exchange wares. This being so, it is obvious that one section of the Press would vehemently attack the Government as the cause of the present state of affairs; manifest, too, that the sapient arguments would ignore the fact of the trouble having been drawing near for years, instead of less than 18 months.

Consols stand below 84½. In that innocent-looking sentence is wrapped a world of woe for the unhappy capitalist who has put his money into investment securities.

The Home Railway market goes from bad to worse. Prices may rise a little on one day, or two consecutive days at the most, and they fall for half a week—steadily. There was a check administered to the drop at the end of last week, but on Monday the flatness broke out again. Central London Deferred has fallen 5 since we wrote; the price now is no better than 51½, the lowest in the history of the stock. The Ordinary shed 2 points to 70. City and South London at 41 is easier. Metropolitan slumped lower than this, the traffics being disastrously down on the half-year. Districts are 13. Great Northern and City Preferred relapsed to 2½.

So long as the Railway Market continues in the unhappy state that has ruled, say, for the past six months, it is quite certain the electrification work on suburban lines will be postponed even by the companies, like the Great Northern, anxious to make the change. The Brighton line, of course, is adapting part of its system to the later form of traction, and the North-Western has definitely put its hand to the scheme for building a separate line to Watford. But there are several others besides the Great Northern which would willingly take up the business were times propitious for obtaining the necessary capital. The which emphatically they are not, and electrical construction companies probably know this better than any others.

Apropos, a correspondent asks for some counsel as to the advisability of selling or holding British Westinghouse Preference shares, purchased at four or five times their present quotation. The question is an extremely difficult one to decide. Westinghouse Preference have come down to the position of being a frank speculation at about 25s. to 30s. for the £5 shares, fully paid, but not cumulative. The last dividend was distributed in February, 1904, and a study of the more recent accounts raises some question as to whether the interest on the Debenture stock would not more prudently have been withheld, having regard to the company's position as shown by the figures. The speculation comes in in the chance that the company may get hold of some particular article, or invention, which it will be able to "run" as a special line of its own. Or, were the Home Railway market conditions to change, and electrification set in strongly amongst steam lines, the Westinghouse Company might again be greatly benefited. The day has gone by for criticising the policy of laying down huge works in anticipation of a business which may not—and in this case has not—come. Hope declines to see the word Ichabod written above the doors of the company, and there has been a slight demand for the shares within the last few days at about 25s. Therefore, some people evidently believe the concern has still a chance, and if the proprietor thinks it well to retain a sporting risk, that is a matter for his own decision; a matter, perhaps, of temperament.

British Electric Tractions have rallied this week, after many days of weary falling. The Ordinary are 12s. 6d. better at 2⅞, and the Preference are 5s. up at 6¾. Yet the 5 per cent. First Debenture stock yielded a point to 100 middle.

Electricity Supply shares maintain the immobility that has become their chief feature. Weakness attacked Edmundson's again, the Preference drooping to 40s., while the quotation for the Debenture stock is widened in the lower direction. Urban Debenture is also rather easier. Oxford shares rose ⅛ to 6¼, and there the list of alteration ends as regards this section.

Nor are Telegraphs much more active. Westerns have again been in demand by the investor who wants 5 per cent. on his money, with good security. The price is 14½ now, and the meeting the other day gave further evidence of the company's strong position. "China" shares, too, are in request; at 14 the price shows ⅛ rise. Cuba Telegraphs of both kinds are ¼ off, and West India and Panama First Preference lost a similar fraction. Indo-Europeans fell ⅛ to 57. The Trust issues remain unchanged, and the same remark covers the Telephone list.

Dublin United Trams are flat at 14, and Anglo-Argentine Ordinary eased off to 7⅝. The miscellaneous group is slightly irregular, Cromptons falling $\frac{1}{16}$, and India-Rubbers ¼, the latter to 15½. Babcock shares, on the other hand, rose to 3$\frac{13}{16}$, iron and steel issues being generally firmer. British Aluminium description are unchanged; the company presents a very good report, in which the necessity for providing fresh capital to cope with increase in business is one of the chief features.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations May 21st.	Closing Quotations May 28th.	Business done week ended May 28th, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	8 — 8½	8 — 8½	..	..	..	Nil
149,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	6 %	5 %	88 — 91	88 — 91	..	..	..	5 9 11
660,660	Anglo-American Telegraph	Stock	6½s.	2⅞%	3½%	3⅞%	61½ — 64½	61½ — 64½	..	..	..	6 0 2
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	6¾%	6 %	6 %	107½ — 109½	107 — 108	108½	107½	— ½	5 11 1
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	½%	1⅜%	20½ — 20⅝	19½ — 19⅝	20⅜	19⅛	— ⅛	8 17 3
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	..	99 — 101	99 — 101	..	..	..	4 19 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	..	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	5 10 4
2,097,680	Commercial Cable Siing. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	92½ — 94½	92½ — 91½	93⅜	92½	..	4 4 8
16,000	Cuba Telegraph	10	0 %	5 %	5 %	5 %	8 — 8½	7⅝ — 8⅛	8	..	— ⅛	6 1 3
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	10 %	16 — 17	15½ — 16½	16½	..	— ½	5 19 5
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	8⅜ — 8⅝	8⅜ — 8⅝	..	..	..	5 8 6
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8⅝ — 9¼	8⅝ — 9¼	..	..	..	5 8 1
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 — 103	100 — 103	..	..	..	4 7 5
60,710	Direct United States Cable	20	8 %	8¾%	4½%	..	15½ — 16	15½ — 16	15⅛	15½	..	5 6 3
60,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 — 102	100 — 102	..	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	136 — 141	136 — 141	141	138½	..	4 19 3
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8¾%	8½%	8½%	88½ — 90½	89 — 91	90	88½	+ ½	3 16 11
1,896,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	104½ — 106½	104½ — 106½	..	..	..	3 15 2
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	13⅝ — 14⅛	13⅝ — 14⅛	14	13⅜	— ⅛	4 18 3
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	104½ — 106½	104½ — 106½	..	..	..	3 15 2
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	98 — 101	98 — 101	..	..	..	4 19 3
230,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	98 — 100	98 — 101	..	..	..	4 0 0
191,127	Globe Telegraph and Trust	10	5⅛%	6⅜%	5⅛%	..	10⅜ — 11⅛	10⅜ — 11⅛	11	10⅜	..	4 18 10
191,127	Do. do. 6 % Pref	10	6 %	6 %	6 %	..	13⅛ — 14⅜	13⅜ — 14⅜	13⅞	13⅛	..	4 3 6
150,000	Great Northern Telegraph, of Copenhagen ..	10	15 %	24 %	24%	20 %	34 — 36	34 — 36	..	..	..	5 11 1
83,500	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 — 102	100 — 102	..	..	..	4 8 3
17,000	Indo-European Telegraph	25	10 %	13 %	13 %	13 %	56½ — 58½	56 — 58	56½	..	— ½	5 12 1
$41,380,400	Mackay Companies Common	$100	..	..	..	..	71 — 3	71 — 3	..	..	..	..
$10,000,000	Do. do. 4% Cum. Pref.	$100	..	..	..	..	69 — 71	69 — 71	..	..	..	..
466,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅞ — ⅞	⅞ — ⅞	19/11½	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord. ..	1	8 %	4 %	5 %	..	1⅛ — 1⅛	1⅛ — 1⅛	..	..	..	4 14 1
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	⅞ — 1	⅞ — 1	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	108 — 110	108 — 110	108½	108½	..	5 9 1
2,225 000	Do. do. Def. Stock	100	5 %	5 %	5 %	5⅛%	104½ — 106½	104½ — 106½	106¼	105⅛	..	5 3 4
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	11½ — 13½	11½ — 12½	..	..	..	4 8 11
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 %	10 — 12	10 — 12	10⅛	..	..	4 3 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅛ — 5⅛	5⅛ — 5⅛	..	..	..	4 9 11
2,000,000	Do. do. 8½ % Deb. Stock Red. ..	Stock	8½%	8½%	8½%	8½%	96½ — 97½	96½ — 97½	..	..	..	3 11 10
1,689,598	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 — 102	100 — 102	100⅞	100⅞	..	3 18 5
179,818	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6¾%	6¾%	7⅜%	7 %	1⅞ — 1⅞	1⅞ — 1⅞	..	..	..	5 4 4
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1⅛ — 1½	1⅛ — 1½	..	..	..	4 16 0
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	98 —101	98 —101	8⅛	..	..	3 19 3
11,889	Reuter's	8	5 %	5 %	5 %	..	7⅞ — 8½	7⅞ — 8½	..	..	..	4 14 1
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
8,167	Submarine Cables Trust	Cer	6 %	6 %	6 %	6 %	127 —130	127 —130	..	..	..	4 12 4
80,000	United River Plate Telephone	5	8 %	8 %	8 %	..	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	5 10 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	..	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	109 —112	109 —112	..	..	..	4 9 3
15,609	West African Telegraph, Shares	10	4 %	4½%	4 %	4 %	10 — 10⅛	10 — 10⅛	..	..	..	3 16 2
80,008	W. Coast of America, 1 to 80,000 & 58,001 to 58,008	2	Nil	Nil	Nil	2½%	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	Nil
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	99 — 102	99 — 102	..	..	..	3 18 5
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	..	13⅜ — 14⅛	13⅜ — 14⅛	14⅛	14	+ ⅛	4 19 1
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102 —105	102 —105	..	..	..	3 16 2
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	⅞ — 1⅛	⅞ — 1⅛	..	..	..	Nil
84,568	Do. do. 6 % Cum. 1st Pref.	10	7 %*	6 %	5 %	8 %	8 — 8½	7⅞ — 8⅛	..	..	— ⅛	9 13 11
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	6½ — 7½	6½ — 7½	..	..	..	Nil
80,000	Do. do. 5 % Debs., Nos. 1 to 1,600 ..	100	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1

Including arrears

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

70,000	Anglo-Argentine Trams, Nos. 260,008 to 310,007, and 560,008 to 580,007	..	..	8 %	8 %	8 %	7⅛ — 7⅞	7½ — 7⅞	7⅞	7½	— ⅛	5 3 3
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	5⅛%	5½%	5½%	5½%	5¼ — 5⅝	5¼ — 5⅝	..	..	..	4 4 3
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	133 —136	133 — 1 6	..	..	..	4 8 3
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	104 —107	104 —107	105	..	..	4 13 6
830,000	Babcock & Wilcox, 1 to 830,000	1	17 %	20 %	20 %	0 %	3⅜ — 4	3⅜ — 4	7s/9	7s/-	..	5 0 0
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅞ — 1⅞	1⅞ — 1⅞ xd	..	..	..	8 15 7
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	..	5¼ — 5⅜	5¼ — 5⅜	..	..	..	6 1 9
40,000	Do. do. 7 % Cum. Pref.	5	Nil	7 %	7 %	..	5¼ — 6¼	5½ — 6½	6⅛	6	..	5 12 0
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	..	5¼ — 5⅝	5¼ — 5⅝	..	..	..	5 4 4
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	..	4 — 4½	4 — 4½	..	..	..	4 8 11
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	..	99 —103 xd	99 —103	101	..	..	4 17 1
800,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5½%	98 —101	98 —101	99	..	..	5 8 11
400,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	6 %	6 %	6 %	123 —127	123 —127 xd	..	..	..	4 14 6
800,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	106 —111	106 —111	..	..	..	4 10 1
800,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	101 —106	102 —106	..	..	..	4 14 4
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	99 —102	99 —102	101	..	..	4 8 3
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	102½—104½	102½—104½	..	..	..	4 6 2
188,301	British Electric Traction	10	6 %	6 %	3 %	..	2 — 2⅛	2⅛ — 2⅜	60/-	58/9	+ 2	9 12 0
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	..	6½ — 7	6½ — 7	6⅞	6⅞	+ ⅛	8 11 5
1,448,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	99—103	98 —102	99	98⅜	—1	4 18 0
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	..	79 — 82 xd	79 — 82 xd	80	79	..	5 9 1
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	10 %	6⅜ — 7	6⅜ — 7	..	..	..	7 2 10
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅜ — 6½	5⅜ — 6½	..	..	..	4 16 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	..	92 — 96	92 — 96	..	..	..	4 13 9
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	..	1 — 1⅛	1 — 1⅛	26/-	25/-	..	Nil
1,016,858	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	64 — 68	64 — 68	..	..	..	5 17 8
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	9/16 — 11/16	9/16 — 11/16	..	..	..	Nil
50,000	¶ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 16/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	2½%	..	½ — ⅝	½ — ⅝	..	..	..	6 13 4
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	..	1 — 1⅛	1 — 1⅛	..	..	..	8 0 0
125,000	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	89 — 92	89 — 92	..	..	..	4 17 10
125,000	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	75 — 78	75 — 78	..	..	..	5 15 5
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	3 %	4 %	3 %	3 %	3⅛ — 3⅜ xd	3⅛ — 3⅜	70/7½	68/11½	..	4 0 0
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4⅛ — 5⅛ xd	4⅛ — 5⅛	..	..	..	5 17 1
27,500	Do "B" do. 1 to 27,500	5	6 %	6 %	6 %	6 %	4⅛ — 5⅛ xd	4⅛ — 5⅛	..	..	..	5 14 3
13,200	Do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	105 —115	105 —115	..	..	..	4 6 11
180,000	Do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..	4 16 2
137,610	Calcutta Trams., 1 to 137,610	5	6 %	8 %	8 %	8 %	7⅛ — 8 xd	7⅛ — 8	7⅛	7⅛	..	5 0 0
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,880	5	..	..	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	4 6 11
860,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	105 —108	105 —108	..	..	..	4 3 4
85,000	Callender's Cable Construction shares	5	12½%	12½%	15%	15 %	10⅛ — 11⅛	10⅛ — 11⅛	10⅛	..	..	6 13 4
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	5⅛ — 5⅜	5⅛ — 5⅜	5⅜	..	..	4 6 11
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106½—108½	106½—108½	..	..	..	4 2 11
491,222	Cape E. Trams., 1 to 491,222	1	10 %	5 %	Nil	..	⅜ — ½	⅜ — ½	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	8 %	1⅛ — 1⅛ xd	1⅛ — 1⅛	24/3	23/9	..	6 1 11
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	..	97 —102	97 —102	98⅜	..	..	4 8 3
911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	71 — 73	69 — 71	70½	69	—2	5 12 8
544,216	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	92 — 94	92 — 94	93⅜	..	..	4 5 1
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	55 — 58	50 — 53	..	..	—5	7 10 11
1,480,000	City and South London Railway	Stock	2⅜%	2⅜%	1½%	2⅜%	41 — 43	40 — 42	41½	40½	—2	5 1 2
85,000	Crompton & Co., Nos. 1 to 85,000	2	2½%	2½%	2½%	..	1⅞ — 2⅛	1⅛ — 2⅛	38/1½	37/-	— 1/16	3 14 0
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 — 99	96 — 99	..	..	..	5 1 6

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated, all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued.)*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(Continued.)*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations May 21st.	Closing Quotations May 28th.	Business done week ended May 28th, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent £ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	..	1 5/16 — 1 3/8	1 5/16 — 1 3/8	..	..	..	7 16 10
805,000	Do. do. 6 % Cum. Pref., 1 to 805,000	1	6 %	6 %	6 %	..	1 3/16 — 1 1/4	1 3/16 — 1 1/4	24/3	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5¾%	6 %	6 %	..	14½— 15½	13½— 14½	..	..	— ¾	4 2 9
59,987	Do. 6% Pref. between 1 and 60,000	10	6 %	6 %	6 %	..	13½— 14½	13 — 14	..	..	— ⅜	4 9 3
99,261	Edison & Swan Utd., "A" shrs., £3 pd., 1 to 99,261	5	Nil	2½%	4½%	..	1½ — 1⅝	1 — 1¼	..	..	— ⅛	9 8 10
17,189	Do. "A" shares, 01—017,189	5	Nil	2½%	4½%	..	2¼ — 2⅜	2⅛ — 2¼	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..	4 12 0
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	89 — 92	89 — 92	..	..	..	5 8 8
112,100	Electric Construction 1 to 112,100	2	4 %	Nil	Nil	..	⅞ — 1	⅞ — 1	..	..	..	Nil
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	7 %	..	1⅞ — 2	1⅞ — 2	..	..	..	7 0 0
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	4 %	5 %	5 %	5 %	8⅝ — 9⅛	8⅝ — 9⅛	..	..	..	5 2 4
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	92 — 95	92 — 95 xd	..	..	..	4 4 3
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	3 %	4 %	4 %	4 %	2¾ — 3	2¾ — 2⅞	45/-	..	— ¼	14 10 10
96,000	Greenwood & Batley 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10½ — 10⅝	10½ — 10⅝	..	..	..	6 13 4
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	11⅝ — 12⅜	11⅝ — 12⅜	..	..	..	5 17 8
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	3 15 7
150,000	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107 —109	107 —109	..	..	..	4 2 7
60,000	India-Rubber, Gutta-Percha & Telegraph Works.	10	10%	5 %	10%	10 %	15½ — 16½	15 — 16	..	..	— ¼	6 5 0
37,500	†Liverpool Overhead Railway, Ord.	10	1⅝%	1½%	Nil	Nil	1½ — 1⅝	1½ — 1⅝	..	..	..	Nil
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	6 — 7	6½ — 7⅛	..	..	+ ⅛	6 13 4
600,070	London United Trams (1901), 1 to 50,007	10	8 %	6 %	8 %	8 %	7 — 8	8¼ — 8⅝	..	..	—1	3 8 7
899,980	Do. do. 60,008 to 100,000	10	8 %	6 %	8 %	8 %	7 — 7⅛	7 — 7⅛	..	..	..	5 2 2
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	7⅛ — 8⅛	7⅛ — 8⅛	..	..	..	5 14 3
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	85 — 89	85 — 89	85½	84⅛	..	4 9 11
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	Nil	1/32 — 1/16	1/32 — 1/16	..	..	..	Nil
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	3/32 — 1/8	3/32 — 1/8	..	..	..	5 3 11
850,000	Do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
30,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 50,000	5	..	6 %	6 %	6 %	4 — 4½ xd	4 — 4½	..	..	..	7 10 0
245,500	Potteries E. Trc.	1	5 %	5 %	4 %	4 %	3/32 — 1/8	3/32 — 1/8 xd	..	..	..	6 8 0
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	3/32 — 1/8	3/32 — 1/8	..	..	..	6 13 4
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	96½ — 99½ xd	96½ — 99½	..	..	..	4 10 6
87,850	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	15 %	30½ — 32½	30¾ — 32½	30¾	30½	..	5 11 1
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100½—103½	100½ —103½	..	..	..	3 17 4
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	74 — 77	74 — 77	..	..	..	6 9 0
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	1½ — 1⅝	1½ — 1⅝	30/-	27/6	..	Nil
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3¾ — 4½	3¾ — 4½	..	..	..	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	79 — 83	79 — 83	..	..	..	4 16 5

ELECTRICITY SUPPLY COMPANIES.

14,003	Bromley (Kent) E.L. & P., 1 to 14,003	5	5 %	5½%	5½%	5½%	4⅜— 5½	4⅜ — 5½	..	..	..	5 4 9
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	97 — 99	97 — 99 xd	..	..	..	4 10 11
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10%	8 — 9	8 — 9	..	..	..	5 11 1
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅛ — 8⅛	7⅛ — 8⅛	..	..	..	4 2 4
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	5 %	3⅛— 4⅛	3⅛— 4⅛	81/3	78/9	..	5 11 1
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4 — 4⅛	4 — 4⅛	..	..	..	5 0 0
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅜ — 4⅛	3⅜ — 4⅛	..	..	..	5 5 11
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 0 10
49,436	Chelsea Electricity Supply, Ord.	5	5⅜%	6 %	6 %	4½%	3⅛— 4⅛	3⅛— 4⅛	..	..	..	4 14 9
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	104 —107	104 —107	..	..	..	4 4 1
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	9⅜ — 10⅛	9⅜ — 10⅛	..	..	..	5 14 3
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11¼ — 12¼	11¼ — 12¼	12⅛	..	..	4 18 0
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	..	..	..	3 19 4
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	97 —100	97 —100	98½	..	..	4 10 0
40,000	County of Durham Electrical Power, Ord.	5	4 %	£3 7 0	4 %	4 %	4⅛— 5	4⅛— 5	..	..	..	4 0 0
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	4⅛— 5	4⅛— 5	..	..	..	5 0 0
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	5 %	5 %	7⅜— 8⅛	7⅜— 8⅛	..	..	..	5 17 8
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10⅛— 11⅛	10⅛— 11⅛	11⅛	..	..	5 4 4
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	106 —109	106 —109	..	..	..	4 2 7
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	95 — 98	95 — 98 xd	..	..	..	4 11 10
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	..	⅜ — 1½	⅜ — 1½	..	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	..	1⅜ — 2⅝	1⅜ — 2⅝	37/6	..	— ½	12 0 0
350,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	87 — 90	85 — 90	..	..	— 1	5 0 0
10,000	Folkestone, 1 to 10,000	5	5⅓%	5⅓%	5½%	5½%	4⅝— 5⅞ xd	4⅞— 5⅞	..	..	..	5 2 4
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	5 — 5½	5 — 5½	..	..	..	4 15 3
90,000	Do. 4½ % 1st. Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 6
18,000	Hove, 1 to 18,000	5	8½%	8½%	9 %	9 %	7 — 7⅛ xd	7 — 7⅛	..	..	..	6 0 0
21,000	Kensington and Knightsbridge Electric Ord.	5	12%	12 %	10 %	10 %	8½ — 9⅛	8⅝ — 9⅛	..	..	..	5 0 0
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	5 6 8
70,000	Do. do. do. 6 % Pref...	5	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	95/-	..	..	5 14 3
874,895	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	95 — 98	95 — 98	..	..	..	4 11 10
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8⅓%	10 %	10 %	8 %	5⅜ — 6⅜	5⅜ — 6⅜	6⅛	6	..	6 8 0
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	4 3 6
230,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	105 —109	105 —109	106½	106	..	4 2 7
260,000‡	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	89 — 93	88 — 93	90⅜	..	— ½	3 15 1
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
67,991	Newcastle-on-Tyne	5	8 %	8 %	8 %	8 %	7⅛ — 7⅞	7⅛ — 7⅞	..	..	..	5 3 5
75,000	Do. 5 % Pref., 1 to 75,000	5	5%	5 %	5 %	5 %	5 — 6	5 — 6	..	..	..	4 3 4
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	12 — 13	12 — 13	..	..	..	5 15 5
64,000	Do. do. 4 % 1st Mort.Deb...	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 0 10
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6⅔%	7 %	7 %	7 %	5⅝ — 6⅜	6 — 6⅛	..	..	— ⅛	5 7 8
60,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	96 — 98	96 — 98	..	..	..	4 1 8
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14⅓%	14⅓%	12½%	10 %	7⅞ — 8⅛	7⅞ — 8⅛	8	7⅞	..	5 17 8
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6½ — 7⅛	6⅝ — 7⅛	6⅞	..	..	4 13 4
160,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	88 — 93	88 — 93	90	..	—2	3 15 3
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	1⅛ — 2⅛	1⅛ — 2⅛	..	..	..	Nil
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	73 — 77	73 — 77	..	..	..	5 3 11
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	3 %	2⅜ — 2⅝	2⅜ — 2⅝	45/-	..	..	5 9 1
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½%	2½%	⅝ — ¾	⅝ — ¾	..	..	..	3 6 8
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	5 1 10
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1⅞ — 2⅛	1⅞ — 2⅛	..	..	..	10 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	2⅜ — 3⅛	2⅜ — 3⅛	..	..	..	7 2 10
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	4½%	4½%	4½%	95 — 98	94 — 97	..	..	— 1	4 12 9
110,000	Westminster Electric Supply, Ord.	5	13⅓%	14 %	18 %	12 %	9 — 10	9 — 10	9⅛	9 3/16	..	6 0 0
81,279	Do do. 4½ % Cum. Pref.	5	5 %	5 %	5 %	4½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	3 18 3
	(Original 5%—Red. to 4½ % from 31st Dec., 1905.											

Unless otherwise stated all shares are fully paid. ‡ Interim dividends

Bank rate of discount 4 per cent. April 25t , 1907

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING APRIL, 1907.

These returns in all the three principal sections are somewhat higher than in the month of March, the exports being approximately £1,500, the imports £2,000, and the re-exports £1,500 to the good, by comparison.

As may be gathered from our remarks in connection with the previous month's returns, the totals of the exports and imports (at £164,924 and £175,812 respectively) are much in excess of the monthly averages obtaining, in the two cases, during 1906; the re-exports, at £11,465, are, however, somewhat below the monthly average of that year. Last month we pointed out that the March imports were the highest recorded by us, up to then; this month's returns are higher still, and, of course, usurp premier position.

Glancing at the individual returns of the various classes of material, the exports of electrical machinery (£69,386) and of electrically-driven machinery (£15,940) show large increases over the preceding month's returns, but cable exports were somewhat less. Electrical machinery imports show a considerable decline on the month, counterbalanced, however, by increased cable imports. The imports of telephone material were considerably less than in March.

The lion's share of the importing falls to Germany and the U.S.A.; the former country, indeed, sent us some £42,500 of cable, an amount only some £500 less than the total of our own cable exports to the whole world.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.*

Country receiving exports and importing.	Electrical goods and appliances.	Electrical cable.	Electric lighting fittings and accessories.	Electric lamps.	Electric meters and instruments.	Electric machinery.	Batteries and accumulators.	Carbons.	Telegraph and telephone material, and electric bells.	Electrically-driven machinery	Tramways apparatus and materials.
	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark	466	...	24	3	585	2,259	...	...	5	250	...
Germany	127	1,862	65	165	49	918	...	13	...	144	...
Netherlands	235	566	300	28	8	226	...	...	...	263	...
Dutch Borneo and Java	...	18	15	18	...	...	6	3	...	...	...
Belgium	128	168	85	63	78	520	5	9	527	...	...
France	244	...	46	...	15	4,870	60	...	...	234	...
French Indo-China and French East Africa	...	...	...	...	...	144	...	...	132	...	...
Portugal, Madeira and Portuguese Africa	...	188	282	4	87	1,067	4	...	89	620	...
Spain and Canary Isles	38	...	119	...	219	48	...	...	...	...	...
Italy and Austria-Hungary	68	...	713	2,062	62	4,745	99	...	...	...	...
Greece, Roumania and Turkey	...	...	...	...	16	3	2	...	12	...	...
Egypt	373	1,461	289	43	227	321	14	...	71	100	...
China and Siam	125	543	123	243	18	3,042	27	...	45	414	...
Japan	21	9,940	81	...	136	7,249	...	...	...	4,110	...
U.S.A., Philippines and Cuba	291	...	18	...	55	15	37	...	...	...	...
Mexico and Panama	...	...	...	11	31	380	...	10	193	4,730	...
Peru, Uruguay and Ecuador	873	531	382	17	...	3,146	5	...	67	...	...
Chili	67	401	75	48	10	3,356	33	19	19	50	...
Brazil	329	1,012	25	34	...	2,535	142	...	70	257	...
Argentine	1,517	1,227	292	1,036	41	5,439	170	24	344	...	...
Channel Isles, Gibraltar and Malta	70	43	45	...	...	677	...	...	...	...	...
British West Africa	3	6	...	9	15	1,735	...	...	...	...	...
Cape of Good Hope	432	2,130	339	292	16	5,755	55	123	17	1,266	...
Natal	2,001	790	370	421	783	326	46	50	...	1,289	...
Zanzibar, Brit. East Africa and Mauritus	79	229	37	...	...	29	43	...	76	...	...
India	2,722	8,380	913	779	1,377	5,857	428	381	581	1,317	182
Burmah	322	2,536	162	25	12	302	6	...	153	9	50
Ceylon	89	...	48	18	...	165	9	...	14	258	...
Straits Settlements, Fed. Malay States, Wei-Hai-Wei, Brit. Borneo and Labuan	58	128	622	66	105	122	36	4	176	98	20
Hong Kong	84	376	328	35	18	103	8	...	...	...	...
West Australia	301	112	68	77	...	1,488	...	...	...	165	...
South Australia	205	...	56	25	...	370	37	...	...	...	...
Victoria	749	4,154	152	37	181	879	...	...	...	3	...
New South Wales	1,027	1,734	211	173	170	8,361	2	16	...	...	...
Queensland and Tasmania	194	...	57	69	...	...	5	3	...	...	...
New Zealand	335	1,472	935	48	...	2,156	...	...	...	363	...
Canada and Newfoundland	116	3,032	125	49	...	740	200	...	12	...	...
British West Indies and British Guiana	67	3	151	25	...	38	3	9	8	...	...
Total, £	13,756	43,042	7,554	5,923	4,314	69,386	1,482	664	2,611	15,940	252

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	£
Russia, Norway, Sweden and Denmark	55	259	110	79	...	2,707	474	...	6,806	...	...
Germany	2,834	42,543	832	1,838	16	15,729	150	3,323	...	13	...
Holland	452	8,451	2,489	6,896	48	2,759	601	2,783	609	...	...
Belgium	763	4,449	390	1,767	267	6,375	274	1,276	11,864	...	...
France	1,249	5,789	4,121	131	495	2,894	1,323	3,613	1,280	50	...
United States	3,739	274	939	223	30	17,705	134	785	86	650	...
Austria-Hungary	...	...	...	...	...	...	...	18	...	...	...
Total, £	9,092	61,765	8,881	10,937	856	48,169	2,956	11,798	20,645	713	...

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	£
Various countries, mainly as above	4,999	367	289	1,024	5	2,121	73	197	1,976	414	...

Total Exports: £164,924

Total Re-Exports: £11,465

Total Imports: £175,812

Note.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

* This section does not include telegraph cables and apparatus.

OF DOGMATISM IN SCIENCE.—II.

By W. M. M.

Of this kind of learning the fable of Ixion was a figure, who designed to enjoy Juno, the goddess of power; and instead of her, had copulation with a cloud, of which mixture were begotten centaurs and chimeras.—*Bacon.*

Electricians are accustomed to measure most things in terms of something else; this were quite reasonable and proper, were it not that they usually assume that the thing measured is that something else in terms of which it is expressed. Naturally they get into difficulties. A unit pole is defined in the same way as a unit of static electricity; therefore both are supposed to contain a factor $M^{\frac{1}{2}}$; because force is measured by the acceleration it produces in a given mass, and the force between two charges or two poles is proportional to their product. Yet they cannot quite bring themselves to believe that electric charge and magnetic pole are the same thing, any more than they can quite believe that resistance is at once a velocity and the reciprocal of a velocity; so they babble of μ and κ and suppressed dimensions, and look forward with a larger faith to the day when all mysteries will be made clear. It never seems to occur to them that the muddle is due to their own assumptions; that a thing may be measured quite reasonably in more than one way; that coffee might just as well be measured by the bushel as by the pound. No, it is *measured* by weight, therefore, it *is* weight. But since they would not accept a pound of chicory and beans for a pound of coffee, they should, to be consistent, introduce a coefficient c, to express its strength and flavour, and tell us that when we know the value of this coefficient, any appeal to the palate will become superfluous.

One of the things measured in terms of something else is current, which is measured by the magnetic flux surrounding it. More than one writer has been inclined to put forward as probable the view that an electric current is that magnetic flux and nothing else. Two circumstances prevented the triumph of that opinion; the preconceptions due to the priority of electrostatic theory, and the ionic theory of electrolysis in its various forms. In these days of electrons the danger is rather that the magnetic flux should be ignored, or thrust into the background, and that attention be fixed mainly on the stream of electrons as constituting the current.

The magnetic flux density at any point, however, depends not only on the current and its configuration, but on the medium in which the flux occurs. The flux then, when the medium is changed, is no longer a measure of the current, and the ratio of the new flux $\mathbf{B}$ to the old $\mathbf{H}$ (which *was* a measure of it) is a coefficient μ. It is rather a makeshift coefficient, since its value varies not only with the medium, but with the flux, and even irregularly with the temperature; still, it is the ratio of two things of the same kind, and, therefore, is of no physical dimensions. At least, such is its nature when one is ordering transformer iron or designing a dynamo. When the object is to impress pupils with the profundity of the professor, $\mathbf{H}$ is substantially identified with the current configuration to which it is due [omitting 4π, which is an accident due to the choice of units] or with the force of permanent magnets, if the flux happen to arise in that way; and μ is expected to bear the burden of the unknown relation between electric current and magnetic flux. The student, when he gets into practical work, will use μ as a numeric, but he will seldom realise that his practice is more logical and more scientific than his professor's theory; that it is unreasonable to pick out one particular flux out of many possible fluxes, and to call it the cause, while the others are effects. The probable result is a mental impression that theory is a very fine thing, to be reverenced and admired at a distance, but rigidly to be divorced from practice.

It appears, then, that in respect of the formula $\mathbf{B} = \mu \mathbf{H}$, electricians depart from their usual practice of measuring a thing in terms of something else: instead, they measure it in terms of something of the same kind, and then make believe that the two are different. There is one other case in which they do the same thing, namely, in the formula $\mathbf{D} = \kappa \mathbf{E}/4\pi$. It may be noted that there is a distinction between these two cases, in that in the former $\mathbf{B}$ changes with the change of medium, $\mathbf{H}$ being constant; whereas in the latter $\mathbf{E}$ is the quantity that suffers change. You do not alter the charge on a sphere by smothering it in paraffin wax, but you do alter its potential, and the electric force within the wax. The effect is the same as though a part of the charge were transferred to the surface of the wax. When the conditions are such that the potential is the thing fixed, as in the case of a condenser as ordinarily used, then $\mathbf{E}$ remains the same, and $\mathbf{D}$ changes according to the dielectric; for then the charge on the plates depends on the capacity. In either case, the displacement at any point, as ordinarily defined, is the density of the lines of force at that point. Now we know nothing of the lines of force, except that their direction gives the direction of the electric force at any point, and their density measures the magnitude of that force; hence $\mathbf{D}$ is a quantity of the same kind as $\mathbf{E}$, differing from it as an ounce differs from a pound. But whence comes the 4π?

There is a curious convention in electrostatics that a body is only affected by the tension of the lines of force attached to itself. The unit charge, the force on which is a measure of the electric force at any point, has 4π lines of force proceeding from it. Let us suppose it placed in a field so strong that all its lines will be carried down stream, so to speak, and that the addition of 4π lines does not sensibly alter the density. Then the force $\mathbf{E}$ at that point will be 4π times the tension of one line of force, and the tension of each line will be $\mathbf{E}/4\pi$ (in air). But the tension of the lines belonging to the test charge is clearly the same as that of the other lines of the field, so that we may suppose the unit charge removed, and in a field of density, D, $\mathbf{D}$ is the tension of a line of force. When the dielectric is changed, $\mathbf{D}$, the displacement, is unchanged, for the total number of lines of force depends on the charge, 4π lines for each unit o charge; and the configuration of the field will not, in general, be altered, so that the density of the lines at any point remains the same, but the tension is diminished in the ratio $1 : \kappa$, and therefore $\mathbf{D} = \kappa \mathbf{E}/4\pi$.

Suppose this equation were shown to an engineer or a mathematical physicist who knew nothing of electric theory—were such an one to be found—and you told him that $\mathbf{E}$ was a force and $\mathbf{D}$ a displacement. He might be puzzled by the 4π, not knowing the eccentricities of electrical measurement, but otherwise he would recognise an old friend. "Displacement proportional to force: Why, that is no other than the mechanical relation between strain and stress, so that the stress be not too great; and κ is the elasticity of the substance strained." Some such notion seems to be at the back of the desire to give a new interpretation to the coefficients μ and κ; it is a perfectly legitimate desire, only our professors ought to recognise that they cannot ride two horses at once. If the displacement is a strain in the ether, there is good reason to think that it is excessively small in respect of the force producing it, and, therefore, κ will be an exceeding small quantity. The old, somewhat fantastic and artificial, definition of displacement would have to be frankly abandoned, and with it the unit value of κ for air (or, rather, for ether). I believe that on these lines something may be done to clear up questions relating to displacement currents in space and the propagation of electric waves; at present "displacement currents" are mere words, with no clear corresponding idea.

Another dogma imposed on us by authority, this time in the great name of Hertz, is that electric waves consist of closed lines of electric strain, which are detached from an oscillator, and move away with the speed of light. I have tried in vain to find any evidence, mathematical or other, for this statement, or any clear definition of a closed line of electric strain. I tried to raise the question before the Institution of Electrical Engineers, but that body is at present wholly devoted to commercial pursuits; and, in any case, is opposed to speculation, or to any tampering with the orthodox faith as handed down to us. So I sought a father confessor in the priesthood itself, and took my doubts and heresies to him. He was exceedingly kind and indulgent. He did not tell me what a loop of force might be, but he explained that it did not shrink up and go out, because of the pressure of other loops inside it. These, I presume, are

in turn kept from shrinking by others inside them, and so *ad infinitum*, like the fleas. I am afraid it is very ungrateful and obstinate of me, but, somehow, I cannot think of a line shaped like a boomerang retaining its form owing to internal pressure; still less of half loops with their feet on a conductor—the very attitude they had before their detachment when they were supposed to be shrinking—not only not contracting, but growing taller as they march across the Atlantic. On that matter I will write no more at present; but if I can succeed in rousing some interest in it, I hope to find an opportunity for discussing it; unless the ring pledged to uphold received opinion prove too strong to be broken.

The high priest of the new dogmatism is unquestionably Sir Oliver Lodge. Not that he objects to bold speculations; he issues them with a frequency which reminds us of

An epic from Bob Southey every spring.

But the speculator must be himself, and from the Brummagem papal chair there is no appeal. His very style is often modelled on the Athanasian creed, that most dogmatic of ecclesiastical formulas:—

Just as a changing magnetic field affects an electrostatic charge . . . . so it is with a changing electric field, it generates a magnetic field proportional to its velocity of charge.

For just as there is no electrostatic field save that extending from one charged body to another, so there is no electric current except the motion of such a charged body, and no magnetic field except that which surrounds the path of this motion.

While the charge is stationary everything is steady and we have an electric field only.

While the charge is moving at constant speed the current is steady, and we have a steady magnetic field superposed on a steadily moving electric field; there is likewise a certain conveyance of energy in the direction of the motion.

One feels inclined to set these last sentences to a Gregorian chant. Again:—

The whole of the fields of an electron are outside itself . . . . for the ether in that space is subject to the co-existence of an electric and magnetic field.

So, also, its inertia resides in space around it, for it is accounted for by the reaction experienced when its magnetic field changes.

We miss the grand roll of the original; but the form is the same and the spirit is the same; only the damnatory clauses are wanting. Perhaps they may be supplied if Sir Oliver should do me the honour to read this article.

But I am wrong in saying that the damnatory clauses are missing. The Grand Inquisitor of Science damns not to rack and fire, or to eternal punishment, but with cold contempt. Whoever shall doubt the adequacy of suppressed dimensions of μ and κ to reconcile the confusion introduced by a double system of units is a person of no importance, and lacks the power of clear thinking. So be it. But clear thinking should lead to consistency and clearness in expression and writing, and, surely, these are far from evident when quantities are defined in one sense, and then used in another, avowedly undefined. Mathematical analysis deals with the quantitative relations of things, and the first condition of its success is that the meaning of each symbol used should be perfectly definite. The dimensions of physical quantities result from the definitions and conventions adopted with regard to their measurement, and it is vain to expect to find more in them than is involved in those definitions and conventions. Already the absurdity of expecting a resistance to be both a velocity and the reciprocal of a velocity has been pointed out, and no juggling with μ and κ can get over it. The late Dr. John Hopkinson once suggested that unit resistance might be taken as the resistance between opposite faces of a unit cube of a standard substance at a standard temperature; in which case its dimensions would be L^{-1}. To those who understand that the dimensions are merely *change ratios*, enabling one readily to change the numerical values of all quantities involved in accordance with a change of fundamental units, the same *system* of relations between the quantities being assumed, these various dimensions of the same thing present no difficulties whatever. It is otherwise with those who expect the dimensions to be a key to the physical nature of the quantities measured.

In the penultimate bull issued from the scientific Vatican, there is a table of terms and symbols used therein, of which the second runs:—

e = the amount of this charge, whether positive or negative; about 3×10^{-10} electrostatic unit.

Yet, throughout the first chapter, e, after being thus carefully defined is used in the sense of *any* charge on a sphere. That, however, is of small moment; but at the opening of the second chapter we find d^2e/dt^2 used for an accelerated charge. It is quite true that d^2e/dt^2 may be written for dc/dt, but then e is the quantity of electricity which passes any section of a conductor per second. If e be an electric charge, whether the charge on an electron or no, it is presumably constant, and any differential coefficient of it is zero. The true expression for an accelerated charge would be $e\,d^2s/dt^2$ if it were moving in a straight line; if in a curve, there would also be a normal component $e\,(d\,s/dt)^2/\rho$ where ρ is the radius of curvature, $= ds/d\varphi$. The error is too obvious to mislead anyone capable of following the context, but it is rather strange that it should have been made, and left uncorrected for four years, by a stickler for "clear thinking."

There is one other minor indication of the tendency to rely on authority, rather than on reason, in modern scientific literature—namely, the perpetual occurrence of proper names. Kelvin's law, the Peltier effect, the Hall effect, Mance's method, Faraday tubes, Lenz's law, the Zeeman effect, Lenard rays, Hertzian waves, and so forth (I have mentioned but a few, and those the most familiar), occur on nearly every page of any modern electrical treatise. It is too much to expect that such references should be always understood; there is other literature, besides that of physical science, worthy the attention of an educated man. To some extent it is inevitable to cite these things by name, but the aim of every writer should be to minimise the necessity.

As for the turbulent ether with a density of a billion, and other most modern views, they must await something approximating to proof before being entitled even to criticism; at present they are to be classed with Ixion's progeny of centaurs and chimeras. As I began with a quotation from Bacon, I will conclude with one: "So it is in contemplation; if a man will begin with certainties, he shall end in doubts; but if he will be content to begin with doubts, he shall end in certainties."

OUR FOREIGN ELECTRICAL TRADE.

THOSE electrical manufacturing firms who contemplate or have already arranged a plan of campaign for developing foreign and colonial trade, ought to acquaint themselves with the organisations that have been established in recent years for the collection of information of commercial value from the countries in which they desire to develop their activities. It is possible that they may find these of greater use to them than are our usual Consular reports which are prepared for everybody in general, and therefore for nobody in particular. It is true that after many years of agitation and dissatisfaction, improvements have been introduced by the present Government, but from what we can gather there are not many among us who treat the sort of information vouchsafed to us in these official documents very seriously, it being of general rather than detailed interest, giving a sort of bird's eye view of things, telling of trends or tendencies, or giving statistics of past trade, and not giving either full enough, early enough, or original, particulars such as are necessary to enable our manufacturers to base definite action thereon.

Reports of tendencies and general conditions are useful in their way, but to our mind they do not go far enough. The exporter wants to know the fullest possible information concerning *probable* openings for business in his particular line, just as soon as that information can be brought to him. So far as we have witnessed their achievements, Consular agencies have not demonstrated any particular ability in meeting the case of the electrical manufacturer or supplier, though we are quite ready to give credit for the success that has attended the efforts made in recent years by the Commercial Department of the Board of Trade to give earlier publication and circulation of such matter as it has at hand.

While we can do with all the assistance that Governments can legitimately render, we are not inclined to think that

our electrical firms will be justified in placing anything more than a slight confidence in Governmental efforts in regard to the collection of trade information. We made our name as a commercial nation through the indomitable business pluck, energy and initiative of our forefathers. Other nations are adding to their reputations to-day, however much they may be aided by tariff conditions, on these very lines. Is it not more of this industrial initiative that we need to-day when our factories are bigger than we require to meet the existing demand, leading to the cutting of prices to get the work we have?

Consider the position of the Consular representative. With so many different classes of trades to report upon, the agents who collect this information for us abroad cannot possibly look at the market through electrical eyes and know where electrical chances exist and what they are. They can only give general sorts of hints in regard to these matters, and often, no doubt, such hints reach their ears because some scheme or other is already on foot, having been started by a foreign promoter or engineer who has settled in his own mind the course of the resultant orders. When a matter has advanced thus far, the information may be—is—absolutely valueless to the Britisher at home, except to tell him that he is being once more defeated. But this Consular agent weakness is inevitable, seeing that these representatives are seldom either engineers or electricians. They can only give information that is known on the spot by somebody else—perhaps to nearly everybody worth considering. As we have said, such information can possess little practical value. "Who gets his blow in fust," is a vulgarism that we have tacked on to a certain Shakespearean clause, and the expression has long been a pregnant one in regard to foreign trade.

We wonder how many electrical firms there are in this country who can point to contracts or concessions which were obtained as the direct result of Consular information published by our Government department. It is true that we see information regarding tramway and lighting schemes in Spain, in Italy, in Norway, and many other places, saying that such and such a man with an unthinkable name has obtained a concession and may want machinery, but it is only once in a blue moon that we see the name of any British firm connected with these schemes when carried out. What we should like to get at is the real practical value of all this Consular collecting as shown by the actual results in business secured. If our manufacturers would relate some of their experiences in regard to this question, they would render important and informing service just at this juncture.

We have said enough to show that we do not expect our Consular service to be a perfect organisation considered separately by every branch of industry. The cost would be altogether too great for the country to bear, as it would involve the employment of an army of specialists, and even then it is debatable how far the country ought to go on piling up expenditure for such matters. The exercise of private enterprise and initiative can never have an effective substitute in Governmental assistance. The Consular service, then, can only be one of many means used with a view to cultivating a closer acquaintance with the outer-world markets; and this fact, if it does anything, points to the need for greater personal attention to the markets themselves on the part of heads or managers of manufacturing firms.

The manufacturers who have trusted much to Consuls to help them in extension of foreign and colonial electrical trade, have trusted to a very broken reed. And those who have gone a bit better and contented themselves with a haphazard circulation of general catalogues, without any special preparation for the particular market—distributing just the same sort of list as they would send, say, to a home buyer, in the English language, and using English measures only—have made but a weak and practically useless attempt in times like these. Local branches in the Colonies have been costly affairs to some of our manufacturers. Why? Local agents are more economical, as is stated in the report of the Brush Co. But it is not in the direction of local selling agencies merely that we need special development—though all well-managed effort of that kind is good at the present time if it does not betray the British manufacturer and put in foreign-made material. What seems to be needed at the present moment is for principals, managing directors, or special accredited technical and commercial representatives, men who know the conditions appertaining to the obtaining of electrical concessions in foreign countries and have made a study of the language, and to some extent of the peculiar characteristics of those foreign countries, to go and find out just what are the immediate prospects and the coming probabilities for British electrical development. We speak with some urgency, because there appears to be need for a great awakening in regard to this matter, if British factories are to do anything like a fair share of electrical manufacturing for foreign needs in the years that are coming on.

The difficulties that confront the electrical manufacturer who is anxious to spread himself well over the foreign markets by getting into responsible personal touch with them, were voiced at the meeting of the Brush Co. last week. One of these seems to be that the managers or responsible chiefs can ill be spared, and that the cost incurred may not be covered at once by the reward. But if we were always controlled in our business practices by such arguments as these, what advance worth having could we ever expect to gain? Do not the foreign competitors have to send responsible men to seek to cultivate business, and do not they run far greater financial risk and find the thing pay well? It is not so many years ago that our works' owners thought nothing of going across the Atlantic to study American methods of manufacture. That was a different kind of inquiry and a different mission altogether, but it was a profitable one, and perhaps a necessary one at the time. Technical engineering matters and works equipment and management problems required men of one stamp to inquire into them. The present problem calls for the going out of men who know the condition of electrical engineering, know how to grasp a situation, how to conduct negotiations, have financial and commercial knowledge and experience, and, above all, are men who can be armed with full powers to make terms and close a bargain on a big scale.

It is to men who contemplate such travels as these, in the hope of bringing perhaps immediate and most certainly future benefit to British electrical manufacturing and industry, that the reports of Consular officials may possess a very real value as one of the many guides that have to be studied before proceeding with the organisation along the best lines of a tour which shall in some way or other bring profit.

Perhaps we dare touch on one other point in connection with the situation. These tours are costly, no doubt, but why treat the expenditure, when discussing it, as though it were outlay merely for immediate gain, and were lost if it did not produce such? We surely all know of businesses where bread cast upon the waters has returned after many days. We have in mind an engineering firm which some years ago sent a traveller to cover the South American market. The ground had to be prepared, orders did not fly in thick and fast at first, but, year by year, long after that traveller's work was done, good business was brought in as the result of connections then made. Then, later, the ground was revisited by the same man for reviving waning influences and seeking out fresh business for which the way had been prepared by the engines and other lines that had been sent into the field by his firm since his earlier visit. The cost was of course considerable, but the step proved highly remunerative in the long run. This may seem all very elementary to some of our readers who are commercial and industrial experts—it is so to us, in a way—and yet we believe it is necessary to talk like this to prevent our looking at so large a matter in too little a spirit.

Some remarks made by Mr. Ebenezer Parkes, M.P., the president of the Birmingham and District Commercial Travellers' Association, are worth quoting in this connection. He said that "what England wanted more than anything else was a set of men who could be sent to any country in Europe, fully qualified to speak to the people in their own languages, and sell them goods in their own system of weights and measures. Then we should have some chance with foreign competitors."

It is said that English manufacturers are "compelled to seek a large proportion of their work abroad." We do not like that word *compelled*. Other nations, we presume, go abroad for choice—because they like it and take glory in large trade expansion. Even we British used to do that! Heaven forfend that we should forget the fact!

PROCEEDINGS OF INSTITUTIONS.

"Flexibles," with Notes on the Testing of Rubber.

By Prof. Alfred Schwartz, Member.

(*Abstract of paper read before the* Institution of Electrical Engineers, *April 18th*, 1907.)

(*Concluded from page* 867.)

XIII.—Attachments for Flexibles.

The attachment to the ceiling rose is, generally speaking, satisfactory in the best forms now on the market. With a view to determine the loads which ceiling roses will support without putting any strain upon the terminals, the three types shown in fig. 12 were selected, and flexibles carefully inserted, the ends

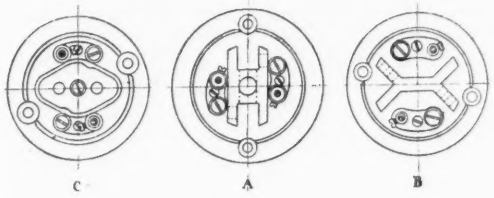


Fig. 12.

being, however, left quite free. The load was applied gradually, and its value noted when slipping commenced. The average loads for slipping are:—A, 40 lb.; B, 27 lb.; C, 45 lb.

In some cases it was found that while the insulated covering maintained its position, the conductors were pulled through owing to the extensibility of the covering being considerably greater than that of the conductor. The hole in the cover of the ceiling rose is in many cases too small to admit C.M.A. flexible, which is much to be regretted, as it certainly limits the present use of this excellent material.

With regard to lamp-holders, with twin-twisted flexible the use of the ordinary single-hole cord grip should be prohibited, and the older form with two slots should be reverted to, so that the conductors may be clamped when separated, and not forced tightly together. In general, the cord-grip arrangement is too cramped in design, and a good deal of improvement might be effected without sacrificing the appearance of the fitting.

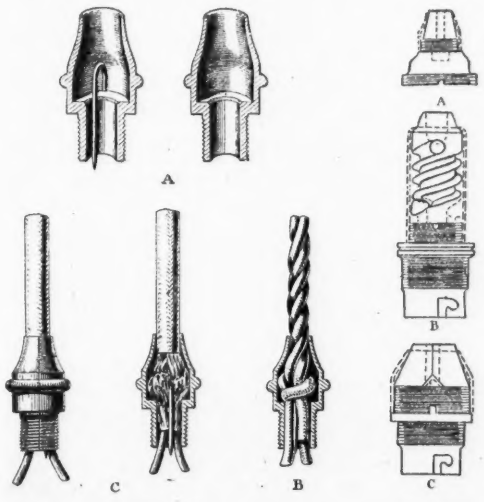


Fig. 13.

Fig. 14.

The cord-grips are commonly made in one piece with a central hole; the wireman has to split the grip down the centre, and enlarge the two half-round channels thus formed to the desired size. The remains of the grip after this operation has been performed are usually of the most slender description.

With circular flexibles the single-hole cord-grip cannot very well be avoided, but in this case the filling that is put in to make up to the circular form helps largely in preventing injury to the insulation of the conductors through their being forced together.

The braiding possesses considerable mechanical strength, and this should be taken down into the grip, the ends being whipped or just touched with a trace of Chatterton to prevent fraying.

An interesting series of cord-grip arrangements has been recently put on the Continental market by Messrs. Hartmann & Braun. The various devices are shown in detail in fig. 13. It must be borne in mind in connection with these fittings that the regulations of the Verband Deutscher Elektrotechniker call for the inclusion of a suspending cord other than the conductors for counterweight flexibles (see Appendix). The nipple which screws into the top of the lamp-holder is made in halves; one half is furnished with a hook, fig. 13 A, which is passed through a knot in the suspending cord, as at B. With flexibles in which the suspending cord is of stout cotton, the hook shown may be placed behind the knot, as at C in fig. 13.

Some types of cord-grip on the English market are shown in fig. 14. The average loads at which slipping took place are given below.

Fig. 14.	Description of grip.	Type of flexible.	Average load in lb. at which slipping took place
A	Boxwood, single-hole	Twin twisted	20·5
B	Scholes' porcelain spiral... ...	"	28·0
C	Boxwood, single-hole	"	18·0
	"Thikflex" holder	Workshop	46·0
D	Boxwood, with two grooves, from old lamp-holders	Twin twisted	53·0

A further set of attachments by Hartmann & Braun are shown in fig. 15.

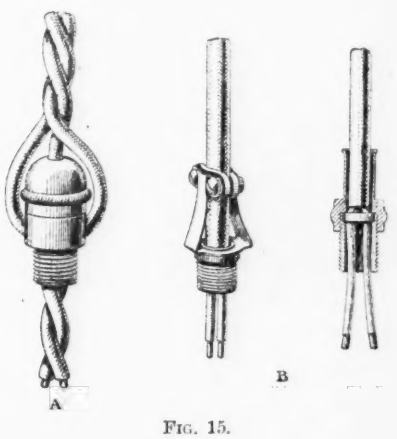


Fig. 15.

In type A the suspending cord is carried into the screw cap and knotted, the conductors entering the nipple at the sides; in type B the suspending cord passes through a hole in the centre of a hard fibre disk and is then knotted while the conductors pass through separate holes at the sides of the disk. Both these types possess the advantage that when in use the flexibles cannot be sharply bent at the lampholder. The weight of fittings commonly supported by flexibles is given in the following table:—

Weight of Fittings commonly used on 35/40 *and* 70/40.

	Lb.	Oz.
Single-light pendant, tulip shade, lamp and holder ...	0	14
Opal shade, 8 in. × 4 in. deep	0	15
Enamelled iron shade, 10 in. × 3¼ in. deep	0	12
Three-light ball fitting, tulip shades, lamps and holders...	2	11
Three-light spider fitting, 12-in. spread shades, &c. ...	2	14

It is essential that arrangements should be made at the ends of the flexible connecting to plugs, terminals, &c., so that sharp bending may be avoided. This can be done quite simply in a number of ways, but is very usually neglected.

XIV.—The Attraction of Dust by Flexibles.

A. A. Campbell Swinton has shown that the collection of dirt on flexibles is due to electrostatic action, and F. G. Baily has pointed out that the sign of the potential with regard to the earth is without, or almost without, influence on the result. On both two and three-wire systems, so long as the switch is on the live side the deposit of dirt will be small, but where it is on the earthed side the deposit will be large, and may extend several inches from the conductor.

With reference to flexible wiring systems, the discoloration of the adjacent walls may be advanced as an objection, but the author would point out that almost any pipe or conduit crossing a horizontal or vertical surface in a room is liable to cause discoloration, which usually takes the form of a light space in the immediate vicinity of the pipe with a dark area beyond it. This is doubtless due to the action of the air currents when passing the obstruction.

APPENDIX.

German Regulations (Issued by the Verband Deutscher Elektrotechniker, June, 1901; amended June, 1904 and 1905).

1. Flexibles may be employed with two classes of insulation, viz.: (1) Rubber put on spirally in the form of tape; (2) rubber in the form of a continuous sheath. Taped rubber flexibles may only be used in dry living rooms for pressures up to 125 volts. They may not be used under dress material or for portable fittings, and may not be installed in cellars, under floors, in bedrooms, or halls. The vulcanised rubber may, however, be used up to 1,000 volts for fixed apparatus and up to 500 volts for portable purposes.

Standard Regulations for Taped and Vulcanised Rubber Flexibles.

2. (*a*) *Taped Rubber Flexibles.*—This insulation may be applied to conductors of from 1 to 4 sq. mm. (0·0015 to 0·0062 sq. in.) in cross-sectional area.

The conductors to consist of stranded tinned copper wires of not more than 0·3 mm. (12 mils) diameter. The conductor is to be spun over with cotton and lapped with unadulterated pure Para strip, which is to be unvulcanised. The overlap of the tapes is to be at least 2 mm. (0·08 in.). The weight of the rubber covering for 100 metres (109·3 yd.) length of single untwisted conductor is not to be less than the following:—

Weight of Insulation on Taped Rubber Flexibles (V.D.E.).

Conductor section.		Weight of rubber covering.	
Sq. mm.	Sq. in.	Grammes per 100 metres.	Lb. per 100 yd.
1·0	0·00155	130	0·262
1·5	0·00232	155	0·313
2·5	0·00388	190	0·384
4·0	0·00620	230	0·464

Note.—For the purpose of testing for the above, the mean of five weighings of one-metre sample lengths is to be taken. Tolerance for dimensions and weight, 5 per cent.

Over the rubber tape each single conductor must have a cotton covering, and over this a braiding of insulating material such as silk or glacé cotton, which must be non-inflammable.

These conductors must, in a dry condition, be capable of satisfactorily withstanding a test pressure of 500 volts alternating for half an hour.

(*b*) *Vulcanised Rubber Flexibles.*—These are permissible in sections of 0·75 to 6 sq. mm. (0·0011—0·0093 sq. in.).

The conductors to consist of stranded tinned copper wire of not more than 0·3 mm. (11·7 mils) diameter.

The conductors are then to be spun over with cotton and enclosed in a water-tight sheath of vulcanised rubber. The quality of the rubber sheath must be such that it will after 24 hours' immersion in water successfully withstand half an hour's application of 2,000 volts alternating between the conductor and the water. The temperature of the water to be not more than 25° C.

The thickness of the rubber covering to be as follows:—

Thickness of Rubber Covering for Vulcanised Flexibles (V.D.E).

Cross-sectional area of conductor.		Thickness of rubber covering.			
		Maximum.		Minimum.	
Sq. mm.	Sq. in.	mm.	mils.	mm.	mils.
0·75	0·00116	1·1	43	0·8	31
1·0	0·00155	1·1	43	0·8	31
1·5	0·00232	1·1	43	0·8	31
2·5	0·00388	1·4	55	1·0	39
4·0	0·00620	1·4	55	1·0	39
6·0	0·00930	1·4	55	1·0	39

Note.—Tolerance for dimensions, 5 per cent.

Each single conductor must be provided over the rubber with a protective sheath, the character of which will depend upon the nature of the work for which it is intended.

(*c*) *Flexibles for Portable Apparatus.*—Conductors for portable apparatus must, in addition to the above, be provided with a suitable covering common to both conductors.

(*d*) *Flexibles for Counterweight Fittings.*—The conductors must have a cross-sectional area of 0·75 sq. mm. (0·0016 sq. in.) made up of stranded tinned copper wires of not more than 0·3 mm. (12 mils) diameter, covered with cotton and with a vulcanised rubber sheath of 0·6 mm. (24 mils) wall. The two conductors are to be made up with a suspending string or cord of suitable material, and are to receive a common braiding of cotton, hemp, silk or similar material. The suspending cord can be double and on both sides of the conductors; if it is metallic it must be itself covered with cotton or braided. In connecting up, the leads should be left longer than the suspending cord. The completed flexibles must be so pliable that single conductors can be worked over pulleys of 25 mm. (1 in.) diameter, and twin conductors over pulleys of 35 mm. (1·38 in.), diameter, without injury. These flexibles in a dry condition must be able to withstand an alternating pressure of 1,000 volts.

Detailed Examination of C.M.A. Flexibles.—Twin-twisted 23/36.

Insulated with Pure Rubber, Separator and V.I.R.

—	Firm A.	Firm B.	Firm C.	Firm D.
Outside covering	Silk	Cotton	Silk	Cotton
Minimum dielectric thickness in mils...	34	36	35	26
Condition of strands ...	Slightly discoloured	Slightly discoloured	Slightly discoloured	Slightly discoloured
Percentage of ash	48·1	48	44·6	42·1
Elongation on 12″ length after stretching to 24″ for 24 hours (three samples) ...	⅝″	7″	⅜″	½″
12″ length broke at	5′ 3″	5′ 1″	4′ 7″	5′ 4″

Discussion.

The discussion was opened by Mr. C. P. Sparks, who thanked Prof. Schwartz for his co-operation in the revision of Institution rules dealing with flexible wiring. Only five years ago there were no practical tests employed on flexible; dry tests were specified, but they were of little use. He favoured the rubber-insulated flexible in use, but could get more exact tests with new vulcanised flexible; the durability and small deterioration of the former were in its favour. The author's tests, also, showed that the flexible tested, more than met the Institution's requirements. Pure rubber flexible was a necessity when there was much bending. He thought the new rules in regard to 5-ampere circuits were very satisfactory. It was only in the last five years that open wiring had been admitted in this country, and the new rules applied to this class of work, which would be facilitated by the sub-circuit system. In his experience the cost per point with the open system was far less than indicated by the author.

Mr. A. Whalley thought the excellent results obtained in practice precluded the necessity of further complicated tests. The author appeared to have ignored the actual size of wire employed in his tests; it was also easy to err in estimating the thickness of tin on wires. As regards the author's Table showing the results of breaking tests on old flexible conductors, he did not think that it supported the conclusion as to V.I.R. cables, as these came out better than the others. In his opinion it was a mistake to put the cotton insulation next the conductor, as the fine cotton fibres penetrated the rubber coating, and so reduced the insulation resistance. There were as many as 40 kinds of Para rubber employed, and the tackiness varied with the process employed in preparation. Temperature had an enormous influence on retractiveness (mentioned by the author), and even handling had an appreciable effect. He further pointed out that it was most difficult to prepare reliable strips of rubber for testing, and asked how the author had proceeded in the matter; also that extraordinary precautions were necessary in order to get rid of moisture if accurate acetone tests were to be made.

Mr. Human (Guardian Assurance Co.) said the net result of the paper was to elevate "flex" in his estimation. He did not hear of many cases of shock through the handling of flexible, although in shop windows it received very rough treatment. He had calculated the probable life of flex (in one case 170 years), from the author's figures, but evidently some deteriorating factor was neglected. He thought that the heat of the lamp might easily affect the figures given. From a mechanical point of view he leaned toward vulcanised india-rubber flexible, but all things considered, he was of opinion that pure rubber insulation was the best. They were entirely in the hands of the cable makers, and must deal with reliable firms.

Mr. M. O'Gorman considered that it was evident that vulcanized rubber flexible was bad stuff; the author had not pointed out that it was unsuitable for sustaining a weight. Vulcanisation rendered the conductor brittle, the braid was like a stocking, and stretched according to the reduction of diameter which occurred on pulleys. He had found plain cotton-covered rubber flex to give much better results, especially in damp places. Low current arcing occurred much more often with the former than the latter kind of insulation. Flex could not be properly tested, but they were right in using it entirely for wiring purposes. The Gymp flex (made by the B.I. & H. Co.) was used on differential pulleys where nothing else stood; it was, however, debarred by the I.E.E. rules.

Owing to shortness of time the discussion was then closed, Prof. Schwartz agreeing to reply in writing.

Mr. Jas. Connolly, in a communication, gave his opinion that hysteresis tests were of great value in estimating the quality of insulating material. The heating tests, described by the author, enabled comparative durability to be determined; the Admiralty heating tests, however, were impossible for pure rubber insulations, although vulcanised samples would pass it. He did not place reliability in chemical tests; certain vulcanised oil substitutes mixed with rubber were not soluble in acetone. He considered it better to dispense altogether with insulation tests, and to adopt conductors insulated with pure rubber lappings. Vul-

canised flex, however, should be tested under water before finishing. There was very little unvulcanised pure rubber used now for insulation purposes, some surface vulcanisation being usually employed. As regards workshop flex, it was quite possible to provide an oil-proof covering; straight wires were not much used for flex at the present day. His firm were making a flexible outer rubber tube to replace the usual fibrous outer covering, which would protect the rubber insulation; it was also a flexible substitute for iron pipe in a water-proof system. He could not agree to the tying of knots in flexibles inside ceiling roses, and his firm advocated the use of a rubber nipple at the entrance of the rose. Surface wiring with flex would be advantageous in this country, as whatever dangers might be latent in such a system, the results were always plainly visible and easily remedied.

The Mechanism of Power Transmission from Electric Motors.

By W. L. Spence.

(Abstract of paper read before The Institution of Engineers and Shipbuilders in Scotland, *February 19th*, 1907.)

The objects of the paper, the author premises, are two:—(1) To bring or keep before engineers possible alternatives to the commoner methods of power transmission from electric motors, so that these latter shall not become stereotyped to the exclusion by sheer forgetfulness of those means, which although not of universal application, still offer decided advantages in certain cases; and (2) to show what are considered typical applications of each system, and to deduce therefrom general conclusions regarding the choice of gear. For these purposes the author describes with illustrations a great variety of systems of gearing. In a summary he states that the motor should be placed well above the floor level, so as to be inspected and cleaned easily, without crawling or lying down: it is a less serious fault to be too high than too low. On the other hand, the height above the base should not be such as to induce vibration. All good motor armatures are symmetrically built, except as regards keying details; most are in fair static balance, but no standard motors are dynamically balanced, hence only slow-speed machines are safe high up. Generally, motors should not be placed on top of any machine or tool, unless it is rooted, so to speak, to the ground. If the machine stands on a stool or cabinet pedestal, it is not a good subject for a motor so placed. The motor should not take up, or prevent from being otherwise used, more floor space than its own area. All standard motors may equally well be fixed to a horizontal, inclined or vertical surface; the inverted position (ceiling) is not a particularly good one. Direct coupled drives are to be preferred to all others whenever practicable. They frequently involve a somewhat more costly motor, occasionally a less costly one; but, always economising on current consumption, their adoption becomes more advantageous as the period of operation is lengthened. Imperfection of alignment is not a bar to direct connection. There are flexible couplings admitting of slight deflection from the straight line, and others suitable for coupling non-intersecting shafts separated by a short and variable distance between centre lines. Apart from their general application which need not be discussed, belt drives are to be preferred to any form of strictly positive connection between constant speed motors and fly-wheel operated machinery. A belt drive should not be accepted as the transmission from an electric motor, on any new tool of the heavy manufacturing (as distinguished from the jobbing) class. A fly-wheel is quite useless with a constant speed motor positively connected to its load. Its utility can be partially restored by a flexible (spring-cushioned) coupling between the motor and the consuming device; where the full advantage of a fly-wheel is desired, the motor should have the speed characteristics of an over-compounded direct-current machine, the speed falling, say, 25 per cent. between no load and full load. Single reduction spur gear (raw hide pinion and cast-iron wheel) admitting of the use of normal speed motors, and regularly purchasable with the motor, is to be regarded as the standard gear transmission for ratios up to 5 or 6, and in extreme cases, with specially heavy wheel patterns, 7 to 1. The idler gear (cast-iron pinion, raw-hide idler and cast-iron wheel) is a substitute for plain S.R. gear, when the distance between centres is too great for the latter. With a steel pinion it may be used for ratios up to 9 to 1. The idler spur transmission is to be preferred to a chain drive (unless with spring wheel), if the load is highly irregular. Chain gear is ordinarily applicable under the same conditions as the last named, but only for ratios up to 5, or 6 to 1. In addition, the silent chain is advantageously employed—(*a*) where the distance between centres is less than, or may be reduced below, that necessary for spur gear; and (*b*) where sufficiently large pulleys cannot be used for belt driving. The chain speed should not exceed 1,200 ft. per minute. For ratios up to about 30 to 1, and where space is not of much account, double-reduction spur gear is applicable. Where space is limited, the special straight line form is appropriate. As treble reduction spur gear necessarily takes up much space and is costly, it should never be decided upon without at least considering possible alternatives. It is applicable for reductions between, say, 40 and 150 to 1. Where extreme compactness with total enclosure of the mechanism is desirable, one or other of the planetary gears may be used; simple for reductions up to 20 to 1 and compound for very high reductions. Where silent running free from vibration is desired, where total enclosure is an advantage, and where a right angle transmission is permissible, there is nothing to equal worm gear. The efficiency for moderate reductions may be high, and the cost lower than that of special gears. Worm gears should not ordinarily be employed for reductions less than 10 or 12 to 1. At 15 or 20 to 1 it shows to best advantage in respect of combined efficiency and dimensions or cost; above 25 or 30 to 1, either efficiency or cost must be sacrificed in comparison with other transmissions.

Discussion.

Mr. Mavor took exception to the author's treatment of the question of fly-wheels, and the arrangement of motors for intermittent work, such as punching and shearing and beam bending machines, and considered that the experience on the east coast of England completely justified the use of polyphase motors for driving shipyard tools. The prevalent practice also seemed to justify the use of shunt-wound in preference to compound-wound motors for the work indicated.

Mr. W. B. Hird said that cases had occurred where the compound-wound motor, put in to do heavy work, had been run at such an excessive speed as to make it difficult to handle the material and get it in between the shears in time for the next blow. That was one advantage of the shunt machine over the compound—that its speed kept practically constant.

Mr. R. A. Bruce, Leeds, said he thought that the case for the worm gear had not yet been fully stated, and that a great many prejudices existed in the minds of eminent and practical engineers which had yet to be dissipated. It had only been within the last five or six years that the commercial production of worm wheels had given them a really effective article. The success of worm gearing depended upon perfect accuracy as to shape and alignment, proper provision for lubricating and for taking the end thrust of the worm, proper choice of the angle of the thread, and the provision of sufficient wearing surface. It was now possible to produce a worm wheel for the same cost as a spur wheel. His firm had supplied, perhaps, the largest example of worm-wheel drive in the world, in the case of a very large lathe for turning guns, driven by a 100-h.p. motor through intermediate spur gearing, and twin worm wheels; the material of the worm-wheel was cast-iron. Under these conditions it had been possible to remove 1½ tons of hard gun-metal in an hour, and that rate of cutting was maintained for five hours. The diameter of the worm at the pitch line was about 10 in., and the maximum load thrown on these worms was 25 tons. Gun-metal had no advantage at all; cast-iron with hardened and ground steel were the two surfaces which gave the greatest possible sustaining powers. For rates of reduction of 6 or 8 to 1, a spiral drive might be substituted, and its efficiency was slightly better than that of the best worm drive. Unfortunately, it was an exceedingly difficult gear to make. In any form of reciprocating tool a large amount of kinetic energy had to be absorbed and re-developed, and the kick of the ammeter needle at the point of reversal of a planing machine was notorious. Fly-wheels and a system of clutches had been devised which had the effect of preventing the extreme kick. A real spring capable of absorbing the whole of the energy of the rotating and moving parts of the machine was a radical remedy for this trouble. This absorbed the energy of the table and re-delivered it within the next stroke, with the result that the power demand was equalized.

Mr. R. A. M'Laren (member) said that apart from cases where a fly-wheel was wanted, he did not think that the positive attachment of a motor to a machine tool was altogether desirable. Taking the case of a radial drill, if the drill stuck in the hole it seemed that there was nothing for it but a smash. No fuse would get over that. He thought the same thing applied to any tool that was directly driven.

Mr. W. W. Lackie (in a communication) said that the key to the proper use of electric motors for driving was sub-division. Undoubtedly the correct way of applying electricity to the driving of works was to abolish shafting as far as possible and put a motor on to each tool. If this were done, economy would be found not only in the total amount of power required but in the annual cost of running, even with electricity at 1d. per h.p.-hour, or 1½d. per unit.

Huronian Co.'s Power Development.

On April 25th a paper was read before the Canadian Society of Civil Engineers by Messrs. R. A. Ross and Henry Holgate, on the electrical installation of the Huronian Co. This was put down to supply the Canadian Copper Co. with power for operating the smelting plant and machinery at the company's copper and nickel mines in the Sudbury district, the water-power of High Falls, 28⅓ miles from Sudbury, being utilised. The power station is designed for four generating sets, each consisting of a three-phase alternator driven by a turbine at a speed of 375 r.p.m., with an effective head of 85 ft. Two of the generators have been installed; they are rated at 2,000 kw. each with a power factor of 0·8, and work at 2,400 volts, 25 cycles. There are two 200-kw. exciters, separately driven at 550 r.p.m., and each capable of exciting four generators. For the purpose of testing the generators, one was coupled up as a motor, with the direction of rotation reversed, and connected with the other machine running as a generator. The machines were excited and switched together before starting; they were then run up together by means of the turbine driving the generator. When full speed was attained, the gates on the wheel connected to the motor were gradually opened, the turbine thus being made to act as a water brake. It was found possible by this means to get any load desired, while the power factor could be varied by over or under exciting the synchronous motor, an advantage which, with others, makes the arrangement much better than the use of a water rheostat.

The operation of the whole station is controlled from a marble bench board, with a pressure of 125 volts. Oil-cooled transformers are employed for raising the pressure to 35,000 volts for the transmission line. The transformers are enclosed in cases of boiler iron, designed to withstand a pressure of 150 lb. per sq. in., and kept full of oil by an elevated tank. Thus no space exists where gas can accumulate; but even if the level of the oil were allowed to sink, no harm would be done by an explosion, as the pressure generated by an explosion of oil gas, it is stated, never exceeds 100 lb. per sq. in. This plan has proved highly satisfactory. The oil is handled by compressed air, dirty oil being run off into a tank and clean oil forced up into the transformer cases.

The transmission line consists of two three-phase circuits of No. 1 wire, carried on double wooden poles with a common cross-arm, and is 29 miles long. The main station at Copper Cliff is equipped with step-down transformers, a motor-generator for operating furnace-charging locomotives at 250 volts D.C., a frequency changer for feeding the A.C. series arc lamp circuits, three blowing engines driven by induction motors of 600 H.P. each, and one of 500 H.P., an air compressor of 300 H.P., pumps, &c., and in the smelter there are two 40-ton A.C. cranes with five motors each, for handling ladles. There are several other sub-stations, at three of which there are 2,300-H.P. three-phase 550-volt induction motors driving compound air-compressors at 120 R.P.M. for supplying air to the mines. Hoists, mine pumps, crushers, &c., are likewise driven by induction motors. The plant commenced work in February, 1906.

NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

11,078. "Improvements in and relating to thermostatic circuit controlling apparatus." E. F. WOODMAN, T. A. KELLEY and G. W. VARNEY. May 13th. (Complete.)

11,079. "Improvements in or connected with joints or contacts for electric conductors." H. SKIPWITH and G. M. NEWBERY. May 13th.

11,086. "Improvements in and connected with telephone receivers." H. W. SULLIVAN. May 13th.

11,099. "Double-pole loose-handle magnetic blow-out circuit breaker." F. WHIPP. May 13th.

11,109. "Overhead spring type of tension for carbon brushes inserted in a box-holder. F. G. DUNN. May 13th.

11,122. "Improvements in accumulator plates." J. T. SZEK. May 13th.

11,123. "Improvements in electric conductors." O. T. HUNGERFORD. May 13th. (Complete.)

11,145. "Improvements in and relating to sparking plugs for internal combustion engines." F. H. SMITH. May 13th.

11,165. "Improvements in electrical distribution." J. S. HIGHFIELD. May 13th.

11,166. "Improvements in the method of generating high-tension direct electric currents." J. S. HIGHFIELD. May 13th.

11,177. "Improved apparatus for holding and compressing objects during their exposure to Röntgen rays. H. J. HADDAN. (Polyphos Elektricitäts G.m.b.H., Germany.) May 13th.

11,178. "Improved method of fastening metallic filaments in electric glow lamps." H. J. HADDAN. (Bergmann-Elektricitäts-Werke Aktiengesellschaft, Germany.) May 13th. (Complete.)

11,182. "Improvements relating to the speed control of bodies driven by alternating-current electric motors." H. A. MAVOR, W. B. HIRD and MAVOR AND COULSON, LTD. May 13th.

11,195. "Improvements in and relating to holders for incandescent electric lamps." W. P. JONES. May 14th.

11,197. "New and improved electrical contact-maker for signal arms." C. H. W. EDMONDS, T. E. HAYWOOD and MCKENZIE & HOLLAND, LTD. May 14th.

11,218. "Trolley head." J. G. LEDWICH. May 14th.

11,262. "Improvements in electrical measuring instruments." E. F. NORTHRUP. (Date applied for under Patents Act, 1901, May 26th, 1906, being date of application in United States.) May 14th. (Complete.)

11,271. "Improvements in and relating to Hertzian wave telegraphy." A. MUIRHEAD. May 14th.

11,285. "Improvements in trolley wheels." A. A. SCHNEIDER. May 14th. (Complete.)

11,288. "Improvements in or relating to alternate current motors." V. A. FYNN. May 14th.

11,289. "Improvements in and connected with the control of electrically-propelled vehicles and trains." H. C. O'BRIEN. May 14th.

11,347. "Improved telephonic dictating system and devices." W. G. HEYS. (General Accoustic Co., United States.) May 15th. (Complete.)

11,352. "Improvements in or connected with electrically-operated or controlled whistles or sound-signalling apparatus." W. J. W. BRUCE. May 15th.

11,353. "Improvements in and relating to devices for determining the resistance of liquids and electrolytes." W. P. DIGBY and C. W. V. BIGGS. May 15th.

11,362. "Improvements in magazine arc lamps." J. BROCKIE. May 15th.

11,381. "Improvements in messenger call installations." SIEMENS BROS. AND CO., LTD., and G. S. GRIMSTON. May 15th.

11,383. "Improvements relating to prepayment electricity meters." A. BAUMANN. (Date applied for under Patents Act, 1901, May 16th, 1906, being date of application in France.) May 15th. (Complete.)

11,402. "Electro-magnetic ignition device for multiple explosion engines." A. RILLING. May 15th. (Complete.)

11,425. "Improvements in and connected with electrical resistances." W. R. LAIDLAW and W. C. LAIDLER. May 16th.

11,450. "Improvements connected with arc lamps." T. MCCLELLAND, JUN., and C. KRATT. May 16th.

11,459. "Improvements in electric switches." J. H. TUCKER, trading as J. Tucker & Co. May 16th.

11,466. "Improvements in induction motors and in the mothod of starting, connecting up and controlling the speed of combinations of such motors." J. L. LA COURT. May 16th.

11,471. "Improvements in the electro-deposition of metals. S. O. COWPER-COLES. May 16th.

11,475. "Improvements in or relating to operating devices for electrical switches for use more particularly in connection with train controlling systems." SIEMENS-SCHUCKERT-WERKE, G.m.b.H. (Date applied for under Patents Act, 1901, June 16th, 1906, being date of application in Germany.) May 16th. (Complete.)

11,476. "Improvements in or relating to dynamo-electric generators and motors." C. W. KAY. May 16th.

11,478. "Improved process for the electrolytic oxidation of isoborneol to camphor." O. IMRAY. (Society of Chemical Industry in Basle, Switzerland.) May 16th.

11,520. "Improvements in electric switches." J. H. TUCKER, trading as J. H. Tucker & Co. May 16th.

11,523. "Improvements in and relating to tramway conduit points." W. KNEEN and H. C. KING. May 17th.

11,528. "Improvements in holders for electric lamps and shades." J. A. GOSLING. May 17th.

11,532. "Improvements in high-tension ignition devices." H. WHIDBOURNE. May 17th.

11,541. "Improvements in means for electrically operating apparatus." H. S. HATFIELD. May 17th.

11,573. "Improvements in electrically operated gas valves." H. HILL and A. E. HACKING. May 17th.

11,582. "Improvements in apparatus for wireless telegraphy." J. A. FLEMING. May 17th.

11,594. "Improvements in and relating to electric motors specially adapted for rolling mills." ALLGEMEINE ELEKTRICITATS-GES. (Date applied for under Patents Act, 1901, May 21st, 1906, being date of application in Germany.) May 17th. (Complete.)

11,598. "Improvements in and relating to dynamo-electric machines." BRITISH THOMSON-HOUSTON CO., LTD. (Allgemeine Elektricitats-Ges., Germany.) May 17th.

11,604. "Improvements in contact voltmeters." H. LEITNER. May 17th.

11,615. "Improvements in or relating to the manufacture of carbon brushes for electrical machines." W. E. LAKE. (La Société Anonyme "Le Carbone," France.) May 17th.

11,616. "Improvements in or relating to electro-magnetic registers." I. FLUEGELMAN. May 17th. (Complete.)

11,621. "Improvements in means for operating alternating current machines in parallel." M. BROOKS and M. K. AKERS. (Date applied for under Patents Act, 1901, January 18th, 1907, being date of application in U.S.A.) May 17th. (Complete.)

11,630. "Improvements in and/or connected with telephones." M. E. A. WALLACE and S. SIBTHORP. May 17th.

11,647. "Telephone register for trunk calls." H. W. LUDLOW. May 18th.

11,667. "Improvements in tremblers of induction coils." J. B. BROOKS and F. H. ALSTON. May 18th.

11,670. "Improvements in electric arc lamps." H. S. HATFIELD and F. M LEWIS. May 18th.

11,673. "Improvements in commutators for electrical machines." S. VON AMMON. May 18th.

11,695. "Improvements relating to radio-telegraphy." THE AMALGAMATED RADIO-TELEGRAPH CO., LTD. (G. Seibt, Germany.) May 18th.

11,701. "Improvements in dynamo-electric machines." THE PHŒNIX DYNAMO MANUFACTURING CO., LTD., and R. POHL. May 18th.

11,706. "Reciprocating ampere-hour continuous-current electricity meter." C. J. TYLER. May 18th.

11,713. "Improvements in or relating to surface contact electric traction systems." E. A. MITCHELL. May 18th.

11,717. "Improved manufacture of incandescence electric lamp filaments of tungsten or alloys thereof." SIEMENS & HALSKE AKTIEN-GES. (Date applied for under Patents Act, 1901, May 19th, 1906, being date of application in Germany.) May 18th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1906.

APPLICATION AND DISTRIBUTION OF ELECTROMOTIVE POWER, PARTICULARLY FOR USE IN STARTING MACHINERY AND FOR SUCH AND SIMILAR PURPOSES. A. W. Mascord. 876. January 12th.

ALTERNATING CURRENT ELECTRIC MOTORS. British Thomson-Houston Co. (General Electric Co.) 3,590. February 13th.

SUPPLYING AND CONTROLLING THE VOLTAGE OF ELECTRIC CURRENTS FROM VARIABLE SPEED GENERATORS, SPECIALLY APPLICABLE TO RAILWAY CARRIAGES AND THE LIKE. Veritys, Ltd., and J. Dalziel. 8,717. April 11th.

APPARATUS FOR INDICATING THE PRESSURE BETWEEN RAILWAY OR TRAMWAY TROLLEY POLES OR LIKE COLLECTORS AND THE CONDUCTORS WITH WHICH THEY ARE IN CONTACT. P. J. Pringle. 8,909. April 12th.

APPARATUS FOR RECORDING SIGNALS GIVEN BY A SHIP'S ENGINE-ROOM TELEGRAPH, AND FOR RECORDING THE MOTION OF THE PROPELLER IN CONNECTION THEREWITH. F. Gloystein. 9,030. April 17th.

ELECTRICALLY PROPELLED VEHICLES. A. Greenwood and W. D. S. Brown. 9,103. April 17th.

MAGNETO-ELECTRIC GENERATORS. Ateliers Thomson-Houston. (Anciens Etablissements Postel Vinay.) 9,117. April 17th. (Date applied for under International Convention, April 17th, 1905.)

ELECTRO-MAGNETIC TRANSMITTING MECHANISM FOR GOVERNORS. D. Bacon. 9,268. April 19th.

POCKET ELECTRIC LAMPS. P. M. Justice. (Deutsche Gasgluhlicht Akt.-Ges.) (Auerges.) 9,346. April 20th.

CONSTRUCTION OF MASTS FOR WIRELESS TELEGRAPHY AND OTHER PURPOSES. L. Leidl. 10,404. May 3rd.

TELEPHONE EXCHANGE SYSTEMS. H. H. Lake. (Stromberg-Carlson Telephone Manufacturing Co.) 10,565. May 5th.

TROLLEY POLES OF ELECTRICAL TRAMCARS AND THE LIKE. J. H. Collie. 13,450. June 12th.

ELECTRIC ARC LAMPS. Jandus Arc Lamp & Electric Co., A. D. Jones and B. M. Drake. 16,162. July 17th.

ELECTRIC ACCUMULATORS. C. Borel and L. Denereaz. 17,987. August 10th. (Date applied for under International Convention, August 11th, 1905.)

APPARATUS FOR THE ELECTROLYSIS OF FLUIDS. E. Weichert. 22,658. October 13th.

MICROPHONES. R. P. O. Berglund, W. A. W. E. Hjorth and C. E. Ljungman. 24,694. November 3rd.

FORM OF STORAGE BATTERY GRID AND MACHINE FOR MAKING SAME. B. J. B. Mills. (C. A. Gould, U.S.A.) 26,820. November 26th.

ELECTRIC TIME SWITCH. O. A. Bruun. 27,684. December 5th. (Date applied for under International Convention, March 29th, 1906.)

ELECTROLYTIC PRODUCTION OF PURE TIN. A. J. M. Thirot and L. A. Mage (called L. A. Nouguier). 28,342. December 12th. (Date applied for under International Convention, March 26th, 1906.)